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Plate Spring Design

The design of plate springs is a subject in which many railway mechanical men have a deep interest. It is one which has been almost entirely based upon theory with but little exact data of a practicable nature by which to check or modify the formulas generally used. On another page appears the first of a series of articles on Plate Springs by G. S. Chiles. These articles are based on the results of extensive tests and contain much valuable data relative to the characteristics of various types of plate springs. The concluding article will be largely devoted to design and will contain recommendations for modifications in the present practice.

Advice to Apprentices

A few weeks ago George M. Basford, who is regarded as the father of modern railway shop apprenticeship, made an address before a meeting of the Chicago & North Western apprentices at Chicago. He took as his subject "Heroes," and clearly outlined the underlying principles which govern the development and advancement of ambitious young men who desire to make good in the railway mechanical department organization. The principles outlined in this article, which is given elsewhere in this issue, are, of course, equally true for young men who desire to advance in any other occupation or profession. The unfortunate part of the whole business is that such a comparatively small number of the apprentices can be forced to stop and think and take advantage of advice of this sort. We hope that not only the young men who read the article will take it to heart, but that the older men who have charge of apprentices will bring it to the attention of the young men and try to get them to realize its great importance to them if they intend to make a success of their work. We shall be glad also to hear from any of the apprentices as to their experiences in regard to apprenticeship and as to how, in their opinion, the instruction which they are receiving and the schedules which they are following could be better arranged to meet the needs of railway shop apprentices of today.

Reclaiming Scrap Material

It is difficult to compare the performances of two different roads in reclaiming scrap, as the conditions are usually very different. The problem in most instances is a local one, and the fact that one road shows a saving in reclaiming certain classes of material does not necessarily mean that another road can obtain the same results. It does indicate possibilities, however, and a study of the conditions under which one road operates its reclaiming plant may show the investigators how their plant might be improved.

The selection of the foreman for a reclaiming plant is of prime importance. The peculiar characteristics of the work require a man who is energetic and ingenious; he must be capable of exercising good judgment in the selection of the material to be reclaimed and of developing methods to make it serviceable at the smallest possible cost. Such a man, with an efficient and well-trained organization, will find no difficulty in showing that money can be saved in scrap reclamation. In addition, he must be supported by competent accountants, men capable of determining very closely the cost of reclaiming the various materials in order that he may know just where he stands. The desirability for this close supervision would indicate that better results can be obtained by having the reclamation work handled by a separate organization located preferably at some important shop point near the scrap market.

The question has been raised as to whether this work should come under the stores or mechanical departments. Both are directly interested. It is the duty of the stores department to keep the purchase of material at the lowest point practicable and still carry enough material to meet the demands of the road. The mechanical department is interested in that it receives the

benefit of the money saved by reclamation. It, therefore, behooves both departments to work together, regardless of which has direct control of the plant. The work itself is, of course, mechanical, and the mechanical men are more capable of determining what can be done in the matter of reclamation.

The question of investment in equipment for a reclaiming plant is also important. There may be just as much money lost in the operation of inefficient machines in the scrap shed as in the best shop on the system, and the use of inefficient machines may mean the difference between a profit and a loss in doing some of the work.

Shop Craft Committee Meetings

The mental attitude of the workman toward his employer is an important item in shop administration. In the railway shop particularly there is often lacking that personal feeling that many times naturally exists between the owner of a small industrial shop and his men. At all of the shops of the Illinois Central an effort has been made to bring the men into closer touch with the organization by the appointment of a shop craft committee. This committee is composed of representatives from each department or craft and meets monthly in the office of the shop superintendent. At these meetings the general welfare of the men, the shop conditions, and safety are discussed with a view to determining at first hand just what complaints the men have, how their working conditions can be improved and to instil into their minds, through their representatives, the necessity of doing their work with the idea of safety to themselves and their fellow workmen. It is explained that the shop is operated on a monthly appropriation basis, and that what they save in material will work towards an increase in what may be expended for labor, which may mean longer hours, with the accompanying increase in pay, or the employment of more help. The men appreciate the fact that the company is seeking to improve their conditions, and in many cases they recommend improvements that are of direct economic advantage to the company. This practice has been in effect for some time and is regarded as an important feature in the shop administration. That the purpose of the committee may be more thoroughly understood by the men, each member is appointed for only two consecutive months, the members being appointed by the men themselves.

The Economy of Good Workmanship

The general foreman of a large eastern shop after showing a visitor a number of examples which indicated clearly the high quality of the workmanship, said, "It doesn't cost any more to do work that way—and it doesn't come back." The conditions obtaining in railway shop work do not tend toward encouraging the highest quality of workmanship. Locomotives must be kept in service the greatest possible proportion of the time and transportation officers are wont to make frequent inquiry as to when certain engines will be ready, so that the shop staff is under a steady pressure in turning out work. There is, therefore, an almost constant tendency, or perhaps it might be more properly termed temptation, to leave something undone or to shirk the method of its doing. Whether or not such practice is cheaper in first cost than if time and care were taken to produce a first class job, there can be no doubt that the after effects are expensive, for such work does "come back" in many ways.

A brief consideration of one or two examples will show very plainly how expensive poor workmanship really is. A locomotive that returns to the engine house from the yard because a cylinder cock that was booked off as O. K. refuses to stay closed, will cost much more in terminal delay to the engine and train crews alone than the expense of doing the job properly and trying the cylinder cocks thoroughly at the shop to insure their working satisfactorily. The widespread effects of any engine failure are of such a nature that the direct cost cannot be counted, but it is safe to say that it would much more than pay for any work that would have prevented the failure. Under the bombardment of questions and requests for power that a foreman receives from the transportation officers he would be superhuman if he did not permit *some* work to go out which could not be classed as good; but an hour or so added to the time an engine is in the shop is many times better than an engine failure. The trainmaster who complains of the length of time a locomotive is held under repairs would complain much more strenuously if the same engine were hurried out and as a result gave up a train on the road. In either case the shop foreman is the victim, but it is a great deal easier to explain a shop delay caused by an effort to prevent an engine failure than it is to explain neglected work which resulted in a failure. The wise foreman will see to it that his work "doesn't come back."

Handling Locomotives at Engine Houses

The function of an engine house organization is to take the locomotives as they come from the trains, make the necessary repairs and prepare them for service as quickly as possible. In the movement of a locomotive through the routine of a mechanical terminal there are two or three points to which we believe greater attention should be given than is the general practice. With regularly assigned engines, which have to lie at a terminal a certain length of time as a minimum, the quicker the work which is done outside the engine house is completed, the more time there will be available for the more important work which is done inside. In the case of pooled engines all of the work must be done as quickly as possible; so that in general it can be stated that despatch should be used in getting locomotives by the coaling plant and over the ashpit. The work of coaling can be done with but slight delay if the equipment is modern; but at an engine house with out-of-date facilities, co-operation with the shopmen is necessary if serious delays are to be avoided. For instance, if an engine is fifth or sixth in the line at the coaling plant and the boiler washing gang is doing nothing pending its arrival in the engine house, the foreman, if he is a man who keeps in close touch with his organization, will order that engine to the ashpit and thence to the house without coal, leaving the work of coaling to be taken care of on the way out, and if necessary having the firing up done enough earlier to provide for this.

At the ashpit, while speed is desirable, care must be taken not to make improper use of the blower and the injectors, and at the same time to carefully clean the fire, or dump it if that is necessary, so that the grates will be left clean. Here again, by keeping in touch with the shopmen, considerable time can be saved. An engine requiring boiler work can be blown down while on the ashpit to a pressure just sufficient to work the engine over the turntable, and a saving both in time and in water can be effected by not working the injectors.

Stress is laid on the quick handling of the outside work, first because a machinist or a boilermaker cannot tell until he has had a chance to carefully examine the work entered in the work book, whether it is likely to result in a long job or a short one. There may be some hidden trouble which was not apparent to the engineman or inspector who made the work report, and if such is the case all the time which is available may be necessary to get the engine ready for service again. Second, the repairing of locomotives is the most important part of the terminal work and the more time given to it, the better the work is likely to be done. An engine house staff should, therefore, be provided with an ample number of capable hostlers and ashpit men to reduce to a minimum the time that locomotives stand outside the shop after their arrival. This is particularly true in the winter months, when it is an easy matter for them to freeze up or develop leaky tubes, causing added trouble and expense, and probably delay.

Steel Frame Passenger Equipment

We have grown so accustomed in the United States to steel cars in passenger trains that we now take them as a matter of course. The public demand for steel cars was met—or at least a start was made toward meeting it—almost before it was made and there are now few roads of importance in this country that do not operate steel passenger train cars in considerable numbers. Some of the mistakes made in the designing of the first cars have been discovered, and are being remedied in later designs; but there is still room for improvement in some of the designs of steel cars now in service, particularly as regards noise and heating. In Canada, where the winter temperatures are much more severe than those encountered in general in the United States, the Canadian Pacific has placed in service a number of steel cars which it is understood are proving satisfactory from the standpoint of temperature, both in summer and winter. These cars were described in the *Railway Age Gazette, Mechanical Edition* for May, 1914, page 237.

In deciding on the use of steel cars consideration must be given to the facilities available for repairs, and the officers of a road on which it will be necessary to go to the expense of building and equipping a shop for repairs to steel passenger equipment if that type of car is adopted, are likely to move slowly, particularly under present conditions. Confronted with the necessity for new equipment in the Montreal suburban service, the officers of the Grand Trunk developed a car design of special interest at this time, when the all-steel car has become so common. This car is described elsewhere in this issue. In order to produce a car with ample strength, which could be kept comfortable in all temperatures and be repaired with the facilities now available on the road, a design was adopted having a steel frame and ends, and reinforced and finished with wood. The danger from fire was carefully considered; but even an all-steel car cannot be made entirely fireproof because of the upholstery, and with steam heat and electric light the danger of fire should be small except in the case of telescoping over the locomotive firebox, a danger which should be slight in this case.

First consideration would lead to the belief that such a car would be unusually heavy, but although the length of the car body is 70 ft., the weight is but 137,000 lb., which with a seating capacity of 96 gives a dead weight per passenger of 1,427 lb. This figure is below the average for all-steel cars, this being about 1,500 lb., while the minimum is in the neighborhood of 1,200 lb. The use of heavier locomotives makes it possible to haul seven of the new cars in a train, giving a total seating capacity of 672 as against 250 in the previous five-car trains, the dead weight per passenger in the latter being 1,500 lb.

NEW BOOKS

The Electric Furnace in Metallurgical Work. By Dorsey A. Lyon, Robert M. Keeney and Joseph F. Cullen. 190 pages, 6 in. by 9 in. Bound in paper. Illustrated. Published by the Department of the Interior, Bureau of Mines, Washington, D. C.

This book is bulletin No. 77, published by the Bureau of Mines and is divided into three parts. Part I treats of the design, construction and operation of electric furnaces. Part II of the smelting of metals in the electric furnace and Part III of the manufacture of ferro-alloys in the electric furnace. The bulletin mittee and is a revision of the questions and answers previously issued by this association.

Steam Charts. By F. O. Ellenwood, assistant professor of Heat Power Engineering, Cornell University. 91 pages, 7 in. by 9½ in. Bound in cloth. Published by John Wiley & Sons, Inc., 432 Fourth avenue, New York.

This book was prepared for the use of engineers, teachers and students who are called upon to solve problems involving the properties of steam, both wet and superheated. For the steam tables usually employed in such work charts have been substituted; with total heat and specific volume as the co-ordinates sets of constant temperature, constant pressure, constant quality, constant superheat and constant entropy curves have been plotted. The graduations have been arranged on a decimal basis, thus facilitating interpolation between the values plotted on the chart. The use of a single chart to include the total range of pressures and temperatures to be met in engineering practice would be extremely awkward. Such a chart in folder form when in use would take up the large part of the top of a desk. Aside from this disadvantage it would soon become worn at the folds and its serviceability greatly impaired. The author has therefore chosen to divide the chart into a number of sections, each section being subdivided horizontally into an upper and lower part, which are placed on facing pages. These pages are preceded by an index chart showing the various sections in their proper relative position and showing the range of values for the variables on each section, by referring to which the proper section to use in any specific case is readily determined. About half of the volume is devoted to problems, the solutions of which are worked out by the use of the charts. The introduction contains a brief statement of fundamental principles, these being included for the benefit of those wishing a brief review of thermo-dynamics, and an explanation of the use of the charts. In addition to the steam charts the book contains tables of barometric corrections and theoretical steam velocities. The graphic presentation of data possesses several advantages over the use of tables and the principal objection to the use of charts—the difficulty of securing sufficient range in practicable space limitations—has been admirably met by the author in this volume.

Examination Questions and Answers. Compiled by a committee of the Traveling Engineers' Association. 205 pages, 4¼ in. by 6½ in. Bound in cloth. Published by the Traveling Engineers' Association, W. O. Thompson, East Buffalo, N. Y., secretary. Price $1 per copy, or 65 cents per copy in lots of five or more.

These questions and answers are for firemen seeking promotion, and for new men to be employed. They were compiled by a committee of the Traveling Engineers' Association, of which W. H. Corbett, division master mechanic of the Michigan Central, was chairman. The book is divided into three series, the first series containing examination questions and answers on which the firemen will be examined at the end of the first year. The second series is for the second year examination, and the third series is questions and answers which the firemen will be expected to know before being promoted to the position of engineer. The first series deals with the fireman's duties and includes considerable information on the combustion of fuel and the proper method of firing. A few questions are also given concerning the air brake.

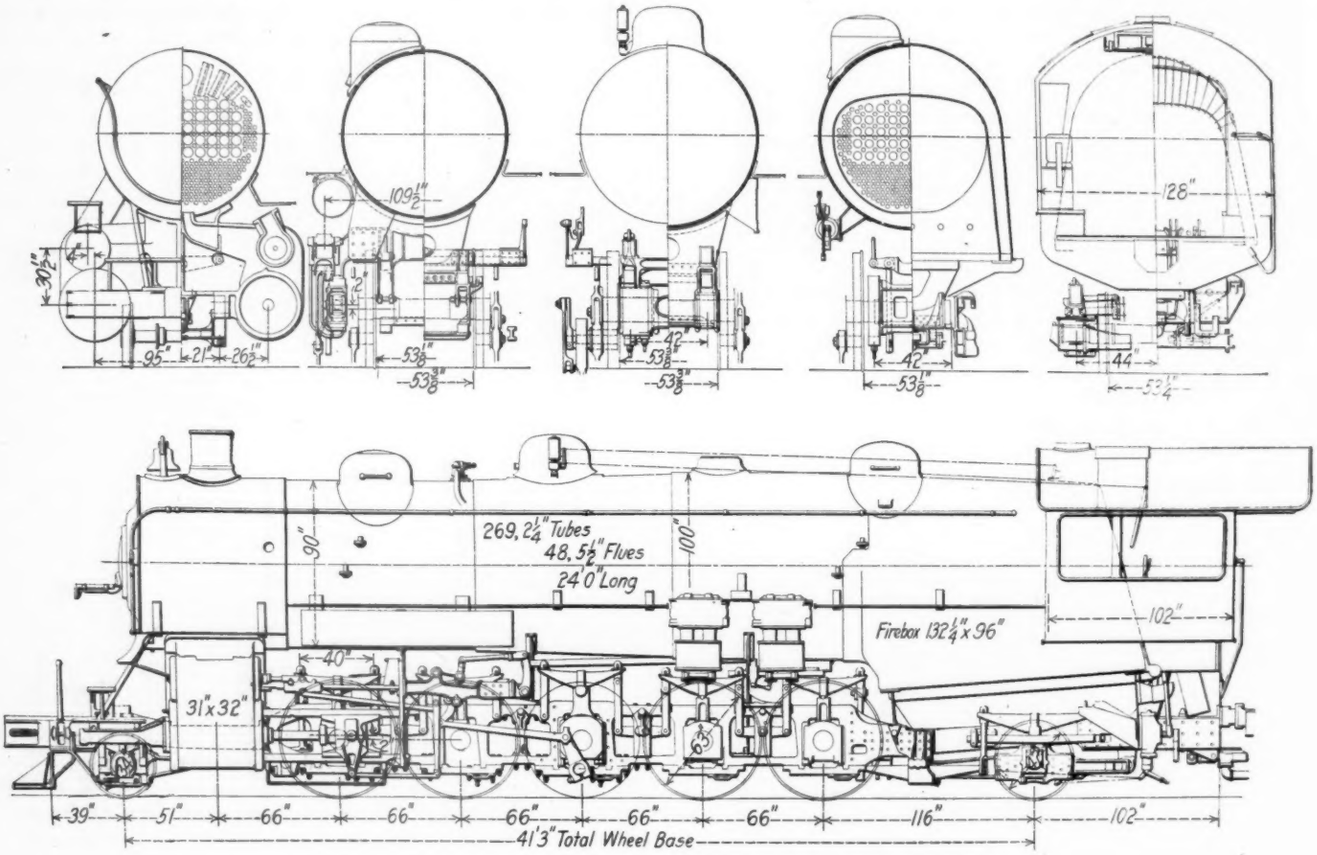
The second series of questions also contains instructions as to the proper method of firing and deals with problems in boiler maintenance and construction with which the fireman should be familiar. It also contains information regarding injectors and lubricators. Further questions are also asked concerning air brakes, and the subject of oil burning locomotives is gone into quite thoroughly. The third series covers the duties of an engineer and gives considerable information regarding the maintenance of the machinery of a locomotive while on the road. This series also includes information regarding break-downs. Compound locomotives are considered in some considerable detail, as are the Walschaert and Baker-Pilliod valve gears, lubricators, and electric head lights. The different types of air pumps and air brake apparatus on locomotives are also considered in considerable detail, 151 questions being asked on this subject. This book was most carefully compiled by the committee and is a revision of the questions and answers previously issued by this association.

Heavy 2-10-2 Type Locomotive

Erie Engine Has 63 in. Drivers, 31 in. by 32 in. Cylinders and Total Engine Weight of 407,700 lb.

A large locomotive of the 2-10-2 type has recently been placed in service by the Erie Railroad. It was built by the Baldwin Locomotive Works and is slightly heavier than the locomotives of this type built last year by the same company for the Baltimore & Ohio.* The new locomotive has 63-in. drivers, the largest which have yet been placed on an engine of the 2-10-2 type, and by using 31-in. cylinders the tractive effort has been maintained very nearly to that of the Baltimore & Ohio locomotives. In the following table is a comparison of the leading dimensions of these locomotives:

Road	B. & O.	Erie
Tractive effort	84,500 lb.	83,000 lb.
Weight on drivers	336,800 lb.	327,250 lb.
Weight, total engine	406,000 lb.	407,700 lb.

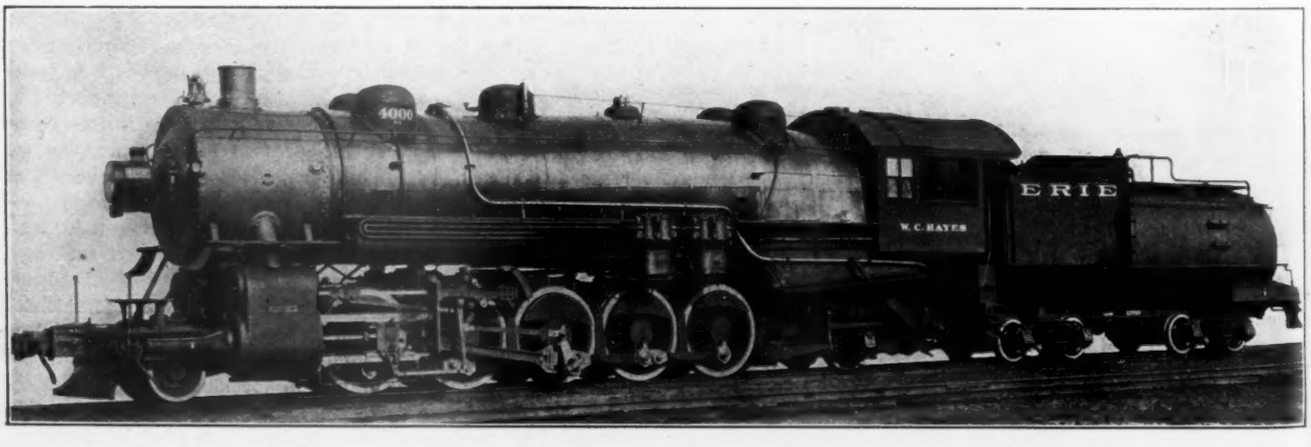


General Arrangement of the Erie Railroad 2-10-2 Type Locomotive

Drivers, diameter	58 in.	63 in.
Cylinders, diam. and stroke	30 in. by 32 in.	31 in. by 32 in.
Steam pressure	200 lb.	200 lb.
Evaporating heating surface	5,573 sq. ft.	5,801 sq. ft.
Superheater heating surface	1,329 sq. ft.	1,377 sq. ft.
Grate area	88 sq. ft.	88.1 sq. ft.

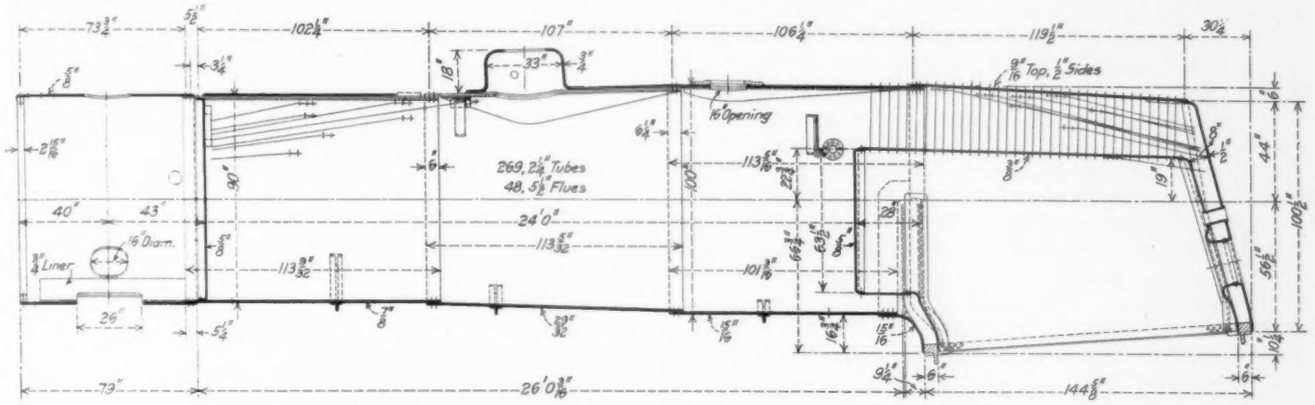
The boiler of the Erie locomotive is similar in construction

*For a description of the Baltimore & Ohio 2-10-2 Type, see *Railway Age Gazette, Mechanical Edition*, September, 1914, page 456.



Erie Locomotive of the 2-10-2 Type Which Develops 83,000 lb. Tractive Effort

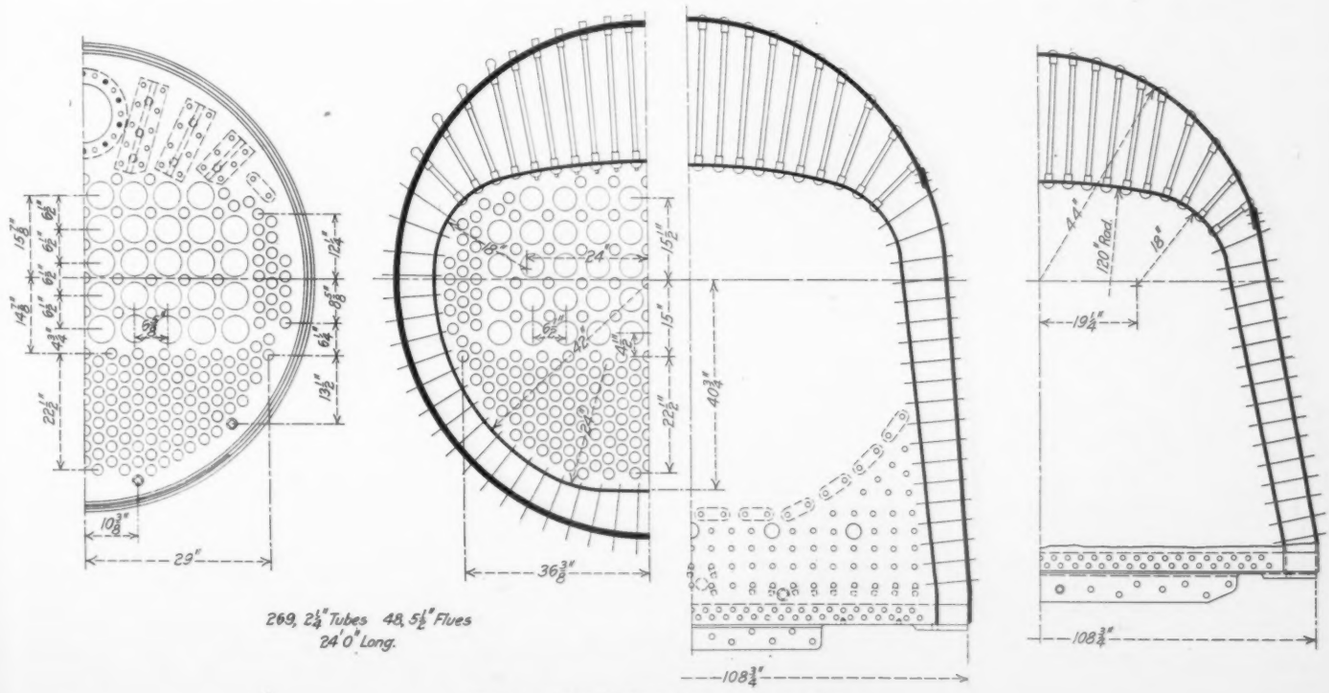
to that of the Baltimore & Ohio locomotive illustrated in the description above referred to. The difference in the heating surface is due almost entirely to an increase in the length of tubes, which are 24 ft. long as compared with a length of 23 ft. in the boilers of the Baltimore & Ohio locomotives. The tubes are welded into the back tube sheet. The new boiler has a conical ring in the middle of the barrel which increases the shell diameter from 90 in. to 100 in. The main dome is of pressed steel in one piece and is mounted on the connection ring, while the auxiliary dome is forward of the firebox on the third ring and is placed over a 16-in. opening in the shell. The boiler contains a combustion chamber 28 in. long. There is a full installation of flexible staybolts in the water legs, and four rows of flexible bolts support the front end of the combustion chamber crown. The equipment includes a Schmidt superheater, Security brick arch, Street stoker, Talmage ash-pan and blowoff system, Franklin grate shaker and firedoor and Chambers throttle valve.



Sectional Elevation of the Boiler of the Erie 2-10-2 Type Locomotive

The cylinder castings are simple and massive in design, and are secured to the frames by 12 horizontal 1½-in. bolts each. Both the cylinders and steam chests are fitted with bushings of Hunt-Spiller gun iron and the same material is used for piston and valve packing rings. In designing the cylinders special attention has been given to the exhaust passages, which are unusually direct and of liberal section area. Steam distribution is controlled by 16-in. piston valves driven by the Baker gear and set with a lead of 3/16 in. The locomotive is equipped with the Ragonnet power reverse gear.

The reciprocating parts are comparatively light for an engine of this size. Forged and rolled steel pistons of Z-section are used. The guides are of the alligator type with a vertical distance of 20 in. between the bars. The crossheads have steel bodies with bronze gibs 32 in. in length and are very simple in design. They weigh 785 lb. apiece, and although large in itself, this weight may be considered low for the size required. The front and back main rod stubs are of the Markel type with removable brasses. As shown in one of the drawings, the cast steel filling blocks in the main stub are cored out to remove as much weight as possible.



Cross-sectional Elevations of the Boiler

Owing to the comparatively large diameter of the wheels and the relatively light reciprocating weights it has been possible to balance the locomotive very satisfactorily. It was unnecessary to resort to the use of auxiliary counterweights on the main axle, and lead has been used in the counter weights of the main wheels only.

The frames are Vanadium steel castings with rear sections

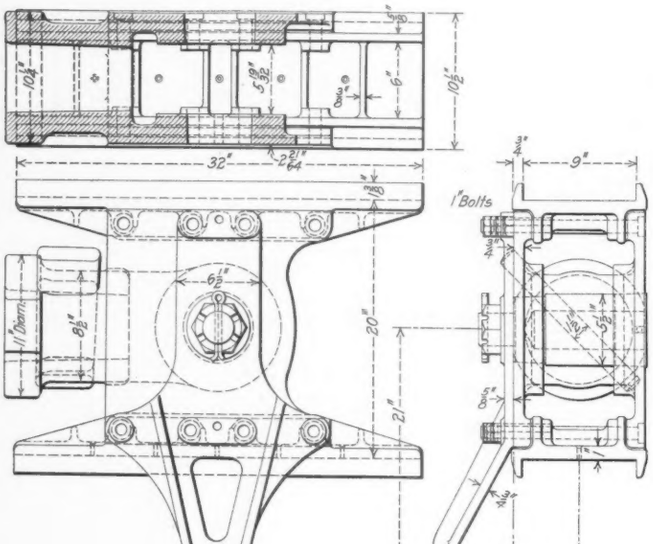
of forged iron. The main frames are 6 in. in width and are spaced 42 in. between centers. The single front rails are cast integral with the main sections and in front of the cylinders they are bolted to a combined deck plate and bumper casting furnished by the Commonwealth Steel Company, in which is housed the Miner draft gear. This is a large and elaborate casting and it has been cored out wherever possible, to save weight. Poling pockets are cast in the bumper.

The driving wheels have a total lateral play in the boxes of ¼ in., and the first and fifth pairs have ¼ in. more play between the flanges and rails than the second and fourth pairs. The main wheels have plain tires, and in spite of the long rigid wheelbase the locomotive will traverse 16-deg. curves. The engine has the Woodard leading truck, the Cole trailing truck and Cole long main driving boxes.

Wherever practicable, details have been made interchangeable with corresponding parts of the Erie's latest Mikado type locomotives. Such parts include the tender trucks complete, the pilot, frame-crossties, brake shoes and heads, many brass fittings and the following parts, except for the main wheels: driving boxes, axles, tires and shoes and wedges. Flange oilers are applied to the leading wheels and a speed recorder is operated from the rear truck.

The tender is of the Vanderbilt type, having a water capacity of 10,000 gal., and a coal capacity of 16 tons. The frame is composed of 6 in. by 4 in. angles, with front and back bumper beams of cast steel. The trucks have cast steel side frames and solid rolled steel wheels manufactured by the Standard Steel Works Company.

The 2-10-2 type, although not yet generally in use, has met with marked success in heavy freight service and the large boiler capacity, together with the comparatively large driving



Crosshead of the Erie 2-10-2 Type Locomotive

wheel diameter of the Erie locomotive, indicates the possibility of further development in this type toward sustained capacity at higher speeds.

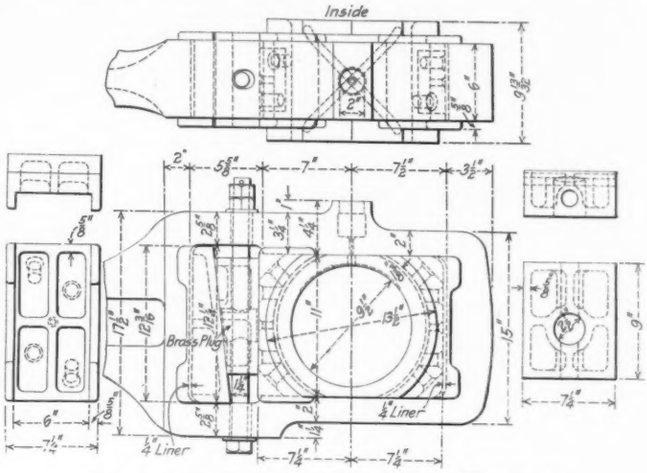
The following are the principal dimensions and data:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Soft coal
Tractive effort	83,000 lb.
Weight in working order	407,700 lb.
Weight on drivers	327,250 lb.
Weight on leading truck	24,450 lb.
Weight on trailing truck	56,000 lb.
Weight of engine and tender in working order	586,300 lb.
Wheel base, driving	22 ft.
Wheel base, total	41 ft. 3 in.
Wheel base, engine and tender	77 ft. 4½ in.

Ratios

Weight on drivers ÷ tractive effort	3.94
Total weight ÷ tractive effort	6.18
Tractive effort × diam. drivers ÷ equivalent heating surface*	664.72
Equivalent heating surface* ÷ grate area	89.29
Firebox heating surface ÷ equivalent heating surface,* per cent	3.28
Weight on drivers ÷ equivalent heating surface*	41.60
Total weight ÷ equivalent heating surface*	51.83



Markel Main Rod Stub with Cored Filler Blocks

Volume both cylinders	27.95 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	281.45
Grate area ÷ vol. cylinders	3.15

Cylinders

Kind	Simple
Diameter and stroke	31 in. by 32 in.

Valves

Kind	Piston
Diameter	16 in.

Wheels

Driving, diameter over tires	63 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	13 in. by 22 in.
Driving journals, others, diameter and length	11 in. by 13 in.
Engine truck wheels, diameter	34 in.
Engine truck, journals	6 in. by 12 in.
Trailing truck wheels, diameter	42 in.
Trailing truck, journals	9 in. by 14 in.

Boiler

Style	Conical
Working pressure	200 lb. per sq. in.
Outside diameter of first ring	90 in.
Firebox, length and width	132¼ in. by 96 in.
Firebox plates, thickness	Sides, back and crown, ⅜ in.; tube, ½ in.
Firebox, water space	6 in.
Tubes, number and outside diameter	269—2¼ in.
Flues, number and outside diameter	48—5½ in.
Tubes and flues, length	24 ft.
Heating surface, tubes	5,443 sq. ft.
Heating surface, arch tubes	37 sq. ft.
Heating surface, firebox	258 sq. ft.
Heating surface, total	5,801 sq. ft.
Superheater heating surface	1,377 sq. ft.
Equivalent heating surface*	7,866.5 sq. ft.
Grate area	88.1 sq. ft.

Tender

Weight	178,600 lb.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	10,000 gal.
Coal capacity	16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

Traffic Through the Panama Canal.—More than a million tons of freight have been carried through the Panama canal during the first three months of its operation. Thus far, the west bound traffic has been in excess of eastbound traffic, westbound being 621,080 tons as compared with 457,991 tons eastbound. More than 95 per cent of this traffic was on the four great routes which developed soon after the canal was opened; the United States coastwise trade, the traffic between the Pacific coast of the United States and Europe, the trade of the west coast of South America with the Atlantic seaboard of the United States and with Europe and traffic between the Atlantic coast of the United States and the Far East.—*American Machinist.*

CHARACTERISTICS OF PLATE SPRINGS

Part I: The Effect of Friction; Relation of Service to Test Deflections; Detecting Permanent Set

BY GEORGE S. CHILES

While much has been written in recent years on plate springs, the treatment of the subject has been largely of a theoretical nature, consisting in the derivation, analysis and comparison of various formulas used in designing springs. The object of Part I of this article will be to describe the characteristics of plate springs as observed in a series of experiments, both in the laboratory and in service. The effect of friction under various conditions is brought out in its relation to methods of testing and to service performance.

Part II will deal with the effect of the characteristics of materials and of methods of manufacture upon the action of plate springs. As far as possible the results of the tests will be used to explain why actual and theoretical performance are often at variance. The bearing of the results upon the subject of design will be considered with suggestions for an improved formula for deflection.

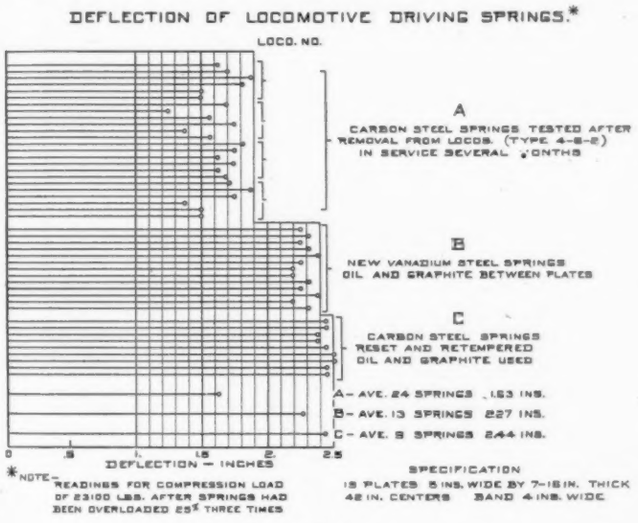

DEFLECTION OF LOCOMOTIVE DRIVING SPRINGS.*
LOCO. NO.
A
CARBON STEEL SPRINGS TESTED AFTER REMOVAL FROM LOCOS. (TYPE 4-8-2) IN SERVICE SEVERAL MONTHS
B
NEW VANADIUM STEEL SPRINGS OIL AND GRAPHITE BETWEEN PLATES
C
CARBON STEEL SPRINGS RESET AND RETEMPERED OIL AND GRAPHITE USED
A- AVE. 24 SPRINGS 1.63 INS.
B- AVE. 13 SPRINGS 2.27 INS.
C- AVE. 8 SPRINGS 2.44 INS.
0 .5 1. 1.5 2. 2.5
DEFLECTION — INCHES
*NOTE— READINGS FOR COMPRESSION LOAD OF 23100 LBS. AFTER SPRINGS HAD BEEN OVERLOADED 25% THREE TIMES
SPECIFICATION
15 PLATES 5 INS. WIDE BY 7-16 IN. THICK
42 IN. CENTERS BAND 4 INS. WIDE

Fig. 1

Before proceeding further the writer wishes to acknowledge his indebtedness to those whose willing co-operation has aided him in securing the data upon which the article is based, especially to R. G. Kelley for his able assistance.

METHODS OF TESTING

In order to secure satisfactory results in testing plate springs it is necessary before recording data to apply and remove an initial load several times, this load varying according to the condition of the springs. For repaired springs or those tested after removal from service the load used amounts to about 25 per cent over the static load for which the spring is designed while for new springs it is usually taken at about 50 per cent over the static load. The limbering up of the spring in this manner eliminates slight irregularities which may be due to internal friction, initial stress resulting from the fitting and banding of the plates and the attendant temperature changes, or the taking of a slight permanent set at or below what is ordinarily considered as the elastic limit of the material. Unless this practice is followed it is impossible to verify deflection readings by duplicating tests. Springs rarely, if ever, return to the original free height after the removal of an initial load even as small as 50 per cent of the static or rated loading.

In deflection tests on steel plate springs the methods to be used require careful attention. Whether the deflection is measured as the load is applied, or as it is released, and what load is to be used in testing for permanent set are questions the settlement of which will seriously affect the results obtained.

In Fig. 1 are plotted the deflections obtained by the application of a compression load of 23,100 lb. to a number of locomotive driving springs. The springs are all of the same general dimensions, but are divided into three groups differing in chemical composition and the method of assembling. The springs in group *A* were built up of carbon spring steel, and were removed from several heavy Pacific type passenger locomotives after having been in service several months. Those in group *B* were new, with a vanadium content; and in assembling, the plates had been painted with a mixture of oil and graphite. Those in group *C* were old carbon steel springs which had been reset, retempered and the plates painted with a mixture of oil and graphite.

After an initial load of 29,000 lb., equivalent to a 25 per cent overload, had been applied and removed three times the camber was measured. The static load of 23,100 lb. was then applied and the camber of the spring again measured. The deflections recorded are the differences between the free camber and that with the static load applied. They varied from 1¼ in. to 1.9 in. for group *A*, the average being 1.63 in. The deflections for group *B* are considerably greater and much more uniform than those for group *A*, ranging from 2.2 in. to 2.4 in. and averaging

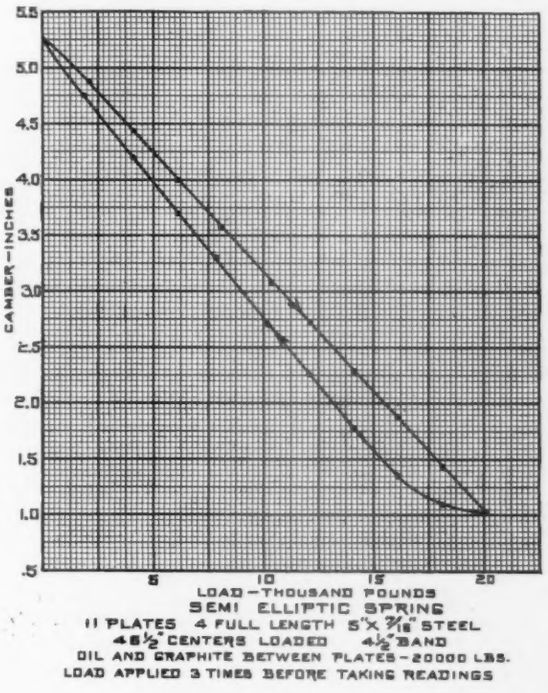


Fig. 2

about 2.27 in. The deflections for group *C* are still greater and more uniform, varying from 2.4 in. to 2.5 in., the average being 2.44 in. It will be noted that the results obtained by this method for new springs with oil and graphite between the plates are fairly uniform while the variations in deflection of old springs are so great as to make the results practically worthless as a means of checking individual springs with formulas or specifications. The causes for these variations will be discussed more

fully later on and attention is called to them at this point only to show the unreliability of data obtained in this manner.

The results of a better method of testing, and one which is quite generally used are shown in Fig. 2. The abscissas represent the load in thousands of pounds and the ordinates the camber of the spring in inches. After being limbered up, the free height, or the camber of the spring, was measured and found to be 5¼ in. The next step was to apply a load of about 2,000 lb., and again record the camber which in this instance was 4.88 in. Without removing this load an additional 2,000 lb. was added, bringing the load up to about 4,000 lb. This reduced the camber to about 4.45 in. In like manner successive points on the curve were determined, the camber gradually decreasing to one inch at a load of 20,000 lb. The operation was now reversed; that is, the load was reduced by about 2,000 lb., bringing it down to 18,000 lb. It should be noted that the camber instead of returning to 1.45 in., is now only 1.10 in. In other words, with the removal of the final increment of 2,000 lb., the spring did not return to the position it had occupied previous to the addition of this increment. Likewise, each successive point on the release load curve will be found to be of smaller value than its corresponding point on the applied load curve, though the difference between the two curves diminishes as they approach the point of zero load, which is the same for both curves.

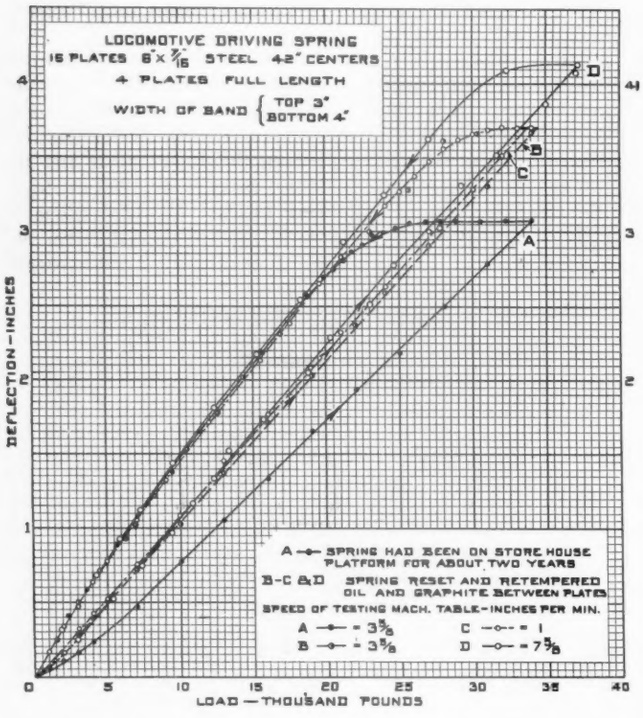

LOCOMOTIVE DRIVING SPRING
16 PLATES 6"x 5/16" STEEL 42" CENTERS
4 PLATES FULL LENGTH
WIDTH OF BAND { TOP 3" BOTTOM 4"
A — SPRING HAD BEEN ON STOREHOUSE PLATFORM FOR ABOUT TWO YEARS
B-C & D SPRING RESET AND RETEMPERED OIL AND GRAPHITE BETWEEN PLATES
SPEED OF TESTING MACH. TABLE-INCHES PER MIN.
A = 3 5/8
B = 3 5/8
C = 1
D = 7 5/8
DEFLECTION-INCHES
LOAD — THOUSAND POUNDS

Fig. 3

The reason for this difference in the camber of the spring for the same load is due mainly to the friction existing between the individual plates composing the spring. To some extent, the time effect must also be taken into consideration. Upon the application of a load, an elastic elongation or deformation immediately takes place, even though the resulting stress is much below the primitive elastic limit, but the permanent or plastic deformation, ordinarily considered a negligible quantity, does not occur until after the elapse of a period of time. As this permanent deformation increases gradually under a constant load, the return of the material to its original state after the removal of the load is also gradual. Since the effect of this phenomena is similar to that of the friction between the plates in that it has a tendency to result in a higher reading for the applied load curve and a lower reading for the release load curve, it no doubt has some effect upon the curves; however, as this effect is comparatively slight, it may be disregarded in this article. In the case of a semi-elliptic spring a small portion of this difference is perhaps due to the friction between the rollers or blocks upon which the ends of the spring rest and the table of the testing machine, although these surfaces were well lubricated. In all instances the load increments were not of the same value. Should any one increment slightly exceed its preceding increment, any attempt toward equalization by removing the excess weight would result in a false value for the curves. In other words, it is to be borne in mind that once having applied a load to the spring, neither this load nor any portion of it should be removed until it is desired to obtain values for the release load curve. Similarly, the values for the release load curve should be obtained only by the removal of the portion of the load and, in no case, should an attempt be made to equalize successive increments of the load by the addition of any amount whatever.

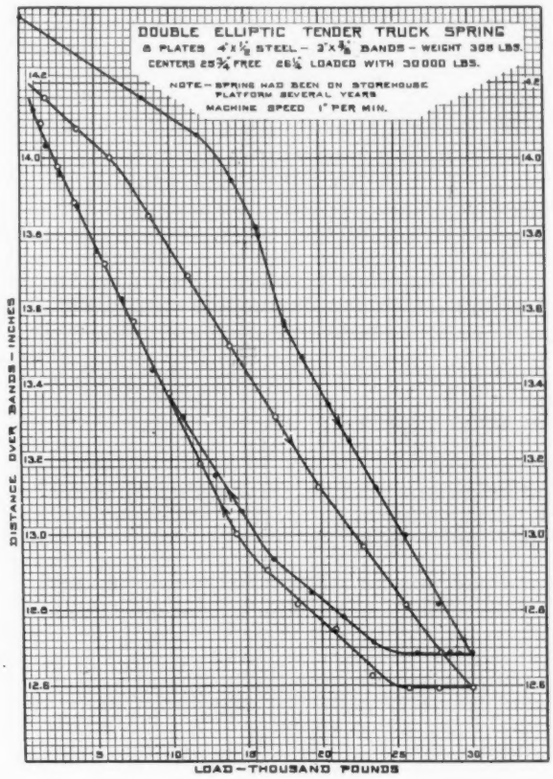

DOUBLE ELLIPTIC TENDER TRUCK SPRING
8 PLATES 4"x 1/2" STEEL — 3"x 3/8" BANDS — WEIGHT 308 LBS.
CENTERS 25 3/4" FREE 26 1/8" LOADED WITH 30000 LBS.
NOTE — SPRING HAD BEEN ON STOREHOUSE PLATFORM SEVERAL YEARS
MACHINE SPEED 1" PER MIN.
DISTANCE OVER BANDS — INCHES
LOAD — THOUSAND POUNDS

Fig. 4

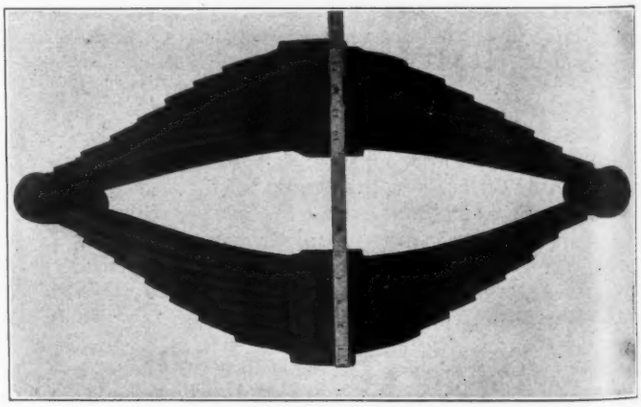


Fig. 5

In order to determine the extent to which the different speeds of the testing machine affected the results, the curves shown in Fig. 3 were plotted, in this case the deflection of the spring in inches being taken as the ordinate instead of the camber. The spring chosen for these tests was selected at random from a number on the store house platform. It was tested with the result shown in curve *A*, but for the purpose in question, it was desired to have a spring with a minimum amount of friction and it was reset, retempered and the surface of the plates painted with a mixture of oil and graphite before being assembled. In this condition it was tested at three different speeds of the testing machine head: 1 in., 3⅝ in. and 7⅝ in. per minute as shown by curves *C*, *B* and *D* respectively. While there is some difference between these curves it is inappreciable so far as it relates to the purpose of the test and may be neglected. As a matter of fact, slight irregularities resulting in some instances, in differences as great as these have been encountered in verifying tests on the same spring.

The reader's attention is called to the important fact that the

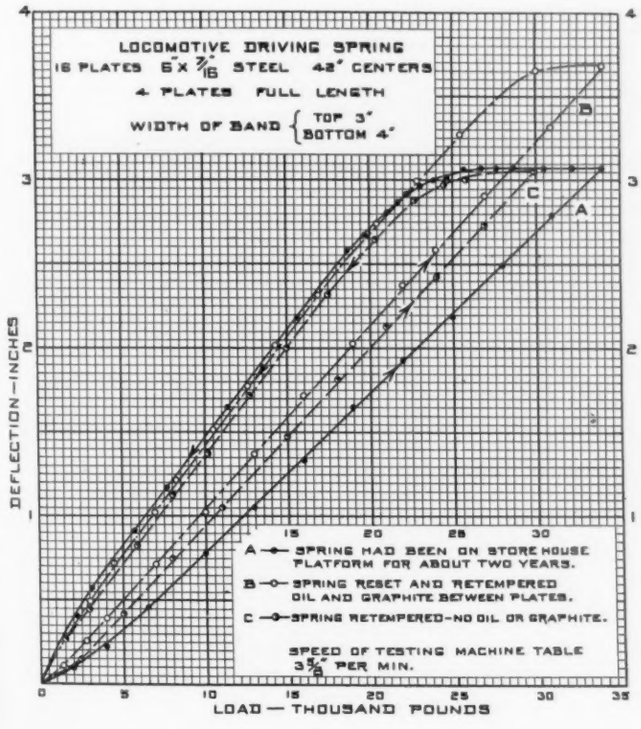

LOCOMOTIVE DRIVING SPRING
16 PLATES 6" X 3/16" STEEL 42" CENTERS
4 PLATES FULL LENGTH
WIDTH OF BAND { TOP 3" BOTTOM 4"
A —●— SPRING HAD BEEN ON STOREHOUSE PLATFORM FOR ABOUT TWO YEARS.
B —○— SPRING RESET AND RETEMPERED OIL AND GRAPHITE BETWEEN PLATES.
C —●— SPRING RETEMPERED—NO OIL OR GRAPHITE.
SPEED OF TESTING MACHINE TABLE 3⅝" PER MIN.
DEFLECTION—INCHES
LOAD—THOUSAND POUNDS

Fig. 6

values of the release load curves are much more uniform than those of the applied load curves.

In order to bring out clearly the necessity for the application of an initial load in testing springs before deflections are recorded the curves of a double elliptic tender truck spring are plotted in Fig. 4. As will be seen from the illustration of the spring in Fig. 5, it had accumulated a heavy coat of rust during several years of exposure on the storehouse platform, this condition serving to emphasize the point in question. The distance over the spring bands before the application of the first load was 14.37 in., and instead of following a straight line, as is usually the case, the applied load curve exhibits a decided hump. The release load curve is also irregular, but to a less degree, and does not return to the same initial point. On the second application of the load the results are more nearly uniform. In this case the release load curve returns to the initial point of the second applied load curve. In some instances as many as five applications of the preliminary loads are necessary to thoroughly limber up a spring and insure reliable results.

THE EFFECT OF FRICTION IN SPRINGS

For the purpose of showing the variations in the deflection of springs due to variations in the condition of the plate surfaces, the spring referred to in Fig. 3 was selected after having been exposed to the weather on an unsheltered storehouse platform for about two years. It was first tested just as it was found, and the result is shown by curves *A* on both Fig. 3 and Fig. 6. It was then reset, retempered, the surfaces of the plates painted with oil and graphite and re-assembled. The test curve then obtained is shown at *B*, Fig. 6, the same testing machine speed being used in both cases. At a load of 34,000 lb. the difference in deflection between the two application curves is .6 in., which may be attributed to the decrease in internal friction in the spring after resetting. The spring was again reset and retempered and assembled without lubricant between the plates. In this condition curve *C*, Fig. 6, was obtained. While the difference between the three release load curves is very slight, the maximum being about .1 in., a marked difference exists between the applied load curves. For a load of 20,000 lb. the difference in deflection between the spring in its original condition and when reset without oil and graphite between the plates is .27 in., or 15.6 per cent. With oil and graphite between the plates a further increase in deflection of .14 in., or 7 per cent was obtained. The total increase in deflection due to resetting and lubricating the plates was .41 in. or 23.7 per cent. The uniformity of the release load curves for wide variations in spring conditions is shown in Fig. 6.

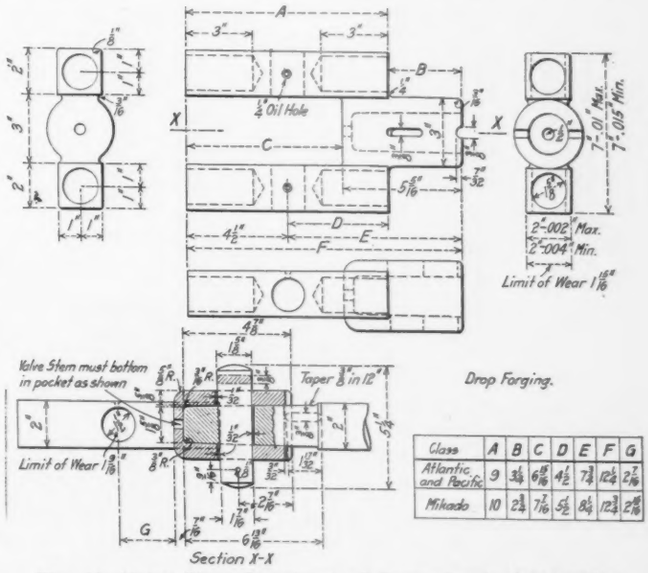
[EDITOR'S NOTE.—The remainder of Part I will be published in an early issue.]

RECIPROCATING AND REVOLVING PARTS

BY H. A. F. CAMPBELL*

PART 1 (*Concluded*).

The valve motion parts of these Pennsylvania locomotives are shown in Figs. 14, 15, 16 and 17. It is not the intention to discuss each part in detail. Looking at the illustrations, these parts seem startlingly light. Every detail towards weight reduction has been carefully considered. Starting right with the pis-

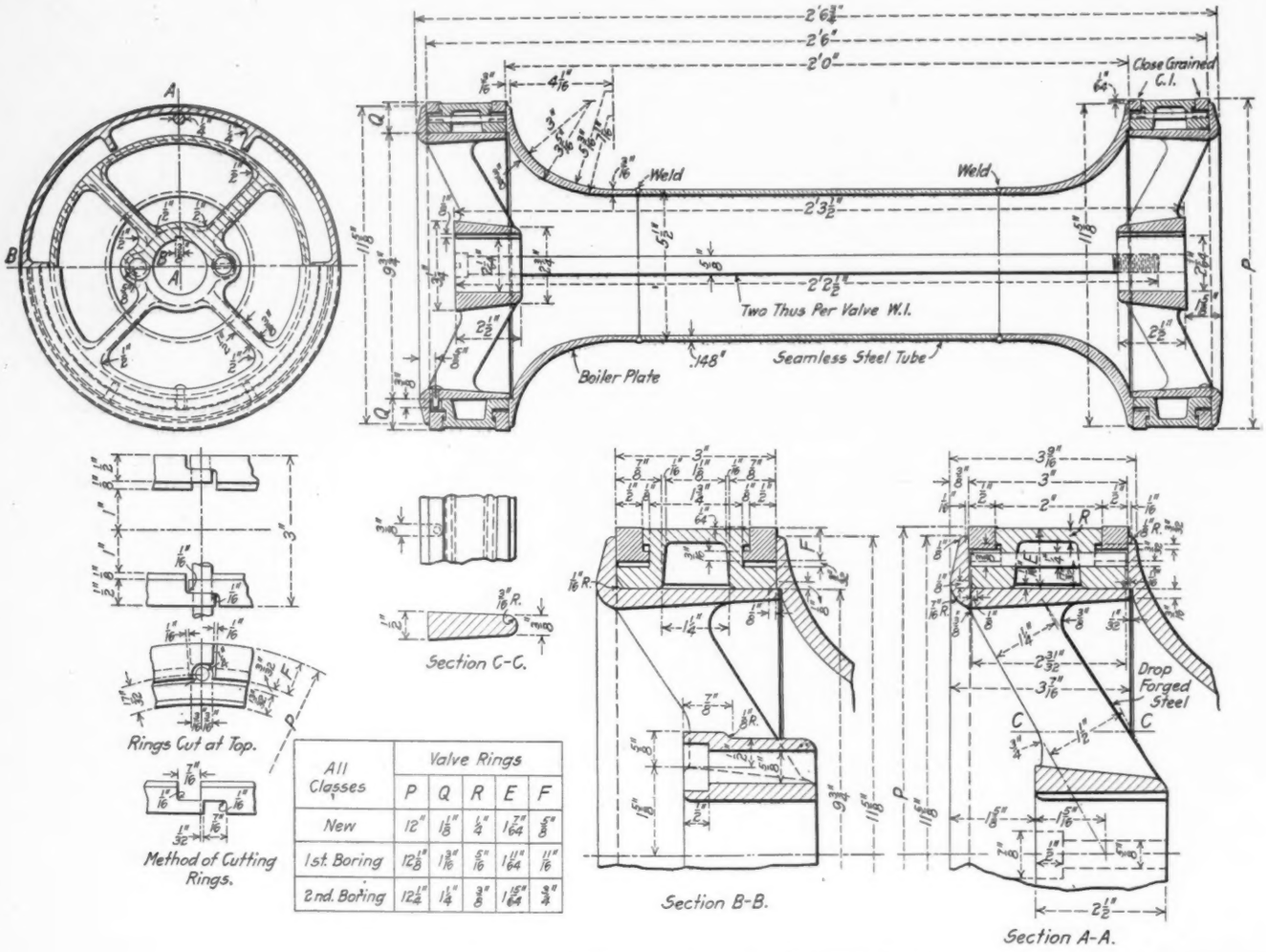


Class	A	B	C	D	E	F	G
Atlantic and Pacific	9	3⅛	6 9/16	4½	7⅛	12¼	2 7/16
Mikado	10	2⅜	7 1/16	5½	8⅛	12⅜	2 9/16

Fig. 14—Valve Stem Crosshead of Pennsylvania Locomotive

ton valve, the valve rod and valve rod crosshead, which are the main inertia parts, the weight has been greatly reduced over ordinary practice. All these parts may seem light, but as some of the principal stresses in them are caused by the inertia

*Baldwin Locomotive Works, Philadelphia, Pa.



All Classes	Valve Rings				
	P	Q	R	E	F
New	12"	1 1/8"	1/4"	1 7/64"	5/8"
1st. Boring	12 1/8"	1 3/16"	5/16"	1 11/64"	11/16"
2nd. Boring	12 1/4"	1 1/4"	3/8"	1 15/64"	3/4"

Fig. 15—Piston Valve Used on the Pennsylvania Locomotives

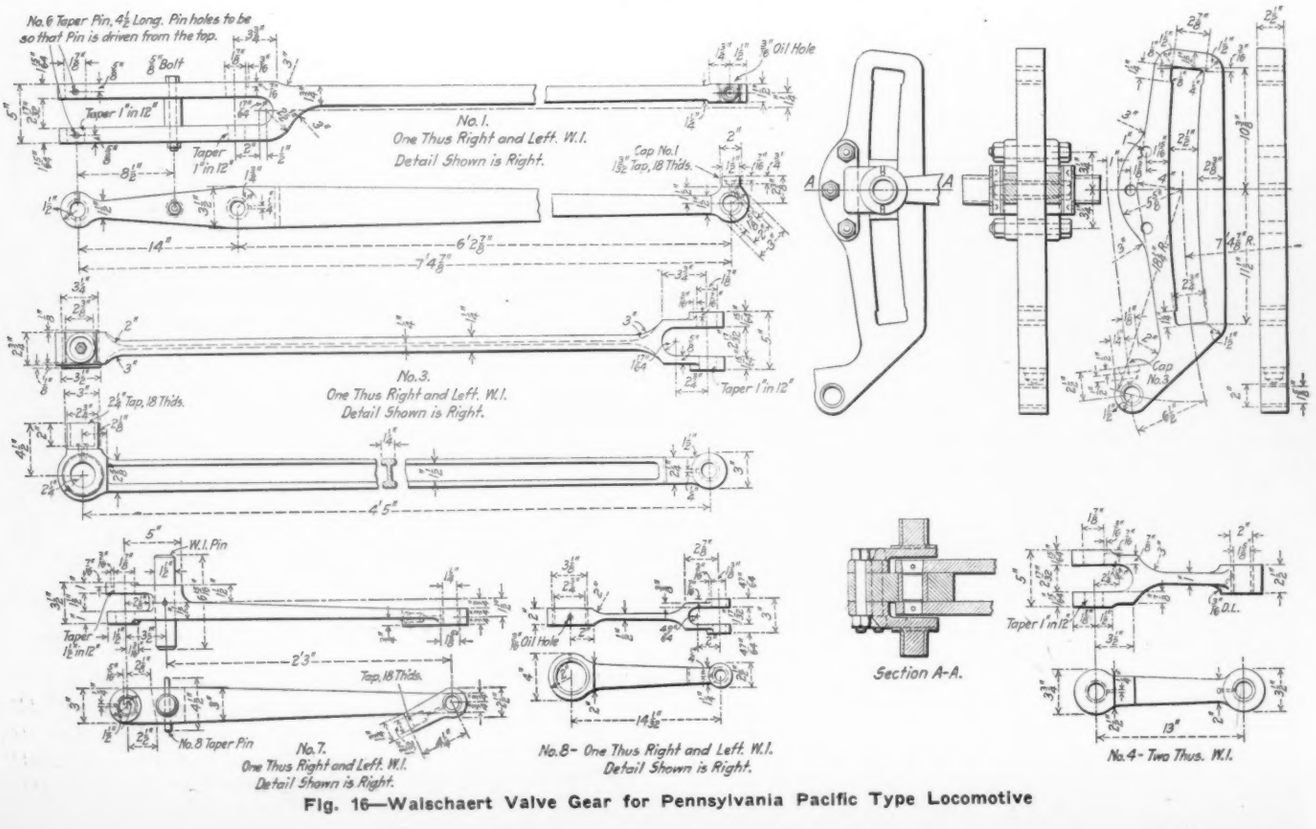

No. 6 Taper Pin, 4½ Long. Pin holes to be so that Pin is driven from the top.
5" Bolt
Taper 1" in 12"
No. 1.
One Thus Right and Left. W.I.
Detail Shown is Right.
Cap No. 1
1½" Tap, 18 Thds.
3/16" Oil Hole
No. 3.
One Thus Right and Left. W.I.
Detail Shown is Right.
2½" Tap, 18 Thds.
W.I. Pin
No. 8 Taper Pin
No. 7.
One Thus Right and Left. W.I.
Detail Shown is Right.
Tap, 18 Thds.
No. 8- One Thus Right and Left. W.I.
Detail Shown is Right.
Section A-A.
No. 4- Two Thus. W.I.

Fig. 16—Walschaert Valve Gear for Pennsylvania Pacific Type Locomotive

forces due to their own weight, it is evident that this very weight reduction has been one of the best safeguards against breakages. The bearing surfaces of some of the pins throughout the motion valves have good lubrication, and the writer believes that the parts here illustrated will give every satisfaction.

The reciprocating and revolving parts designed for a 2-10-2

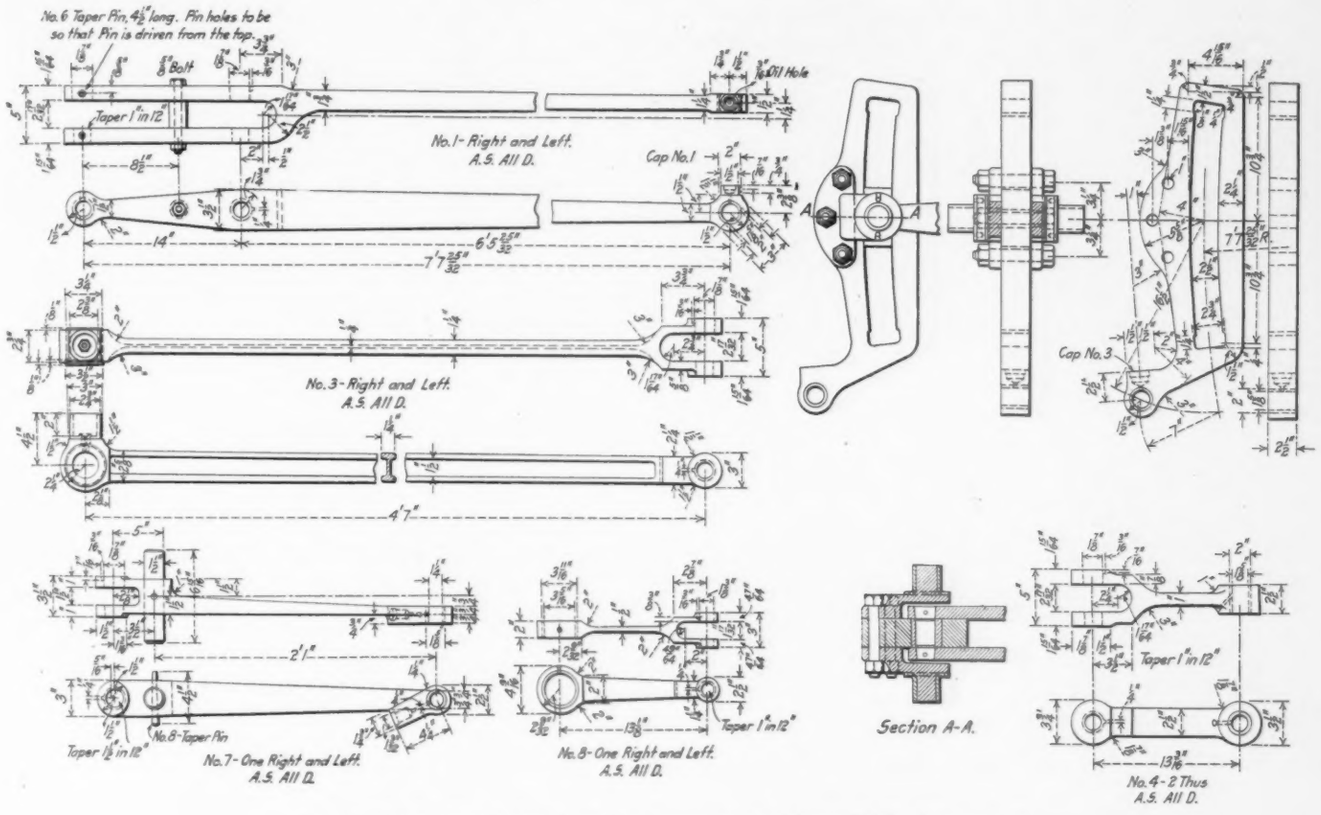

No. 6 Taper Pin, 4½" long. Pin holes to be so that Pin is driven from the top.
Bolt
Taper 1" in 12"
No. 1 - Right and Left. A.S. All D.
Cap No. 1
Oil Hole
No. 3 - Right and Left. A.S. All D.
Cap No. 3
No. 7 - One Right and Left. A.S. All D.
No. 8 - One Right and Left. A.S. All D.
No. 8 - Taper Pin
Taper 1½" in 12"
Section A-A.
No. 4 - 2 Thus A.S. All D.

Fig. 17—Walschaert Valve Gear for Pennsylvania Atlantic Type Locomotive

seem very small, but are probably not too small when we consider the reduced pressures that come on them.

It may be remembered that the Pennsylvania Railroad purchased one of the French four-cylinder DeGlehn compounds. This engine had unbalanced valves, but the valve motion parts were very light and the writer heard it authoritatively stated that after the engine had made a certain mileage it was carefully examined and it was found that the wear of the valve motion parts was absolutely nothing. The wear of the valve motion parts is mostly caused by their own weight, assuming that the type freight locomotive built in 1914 by the Baldwin Locomotive Works for the Chicago, Burlington & Quincy, will next be considered. The railroad already had one engine of this class and size, the cylinders being 30 in. by 32 in., the drivers 60 in. in diameter, the boiler pressure 175 lb., and the weight on drivers

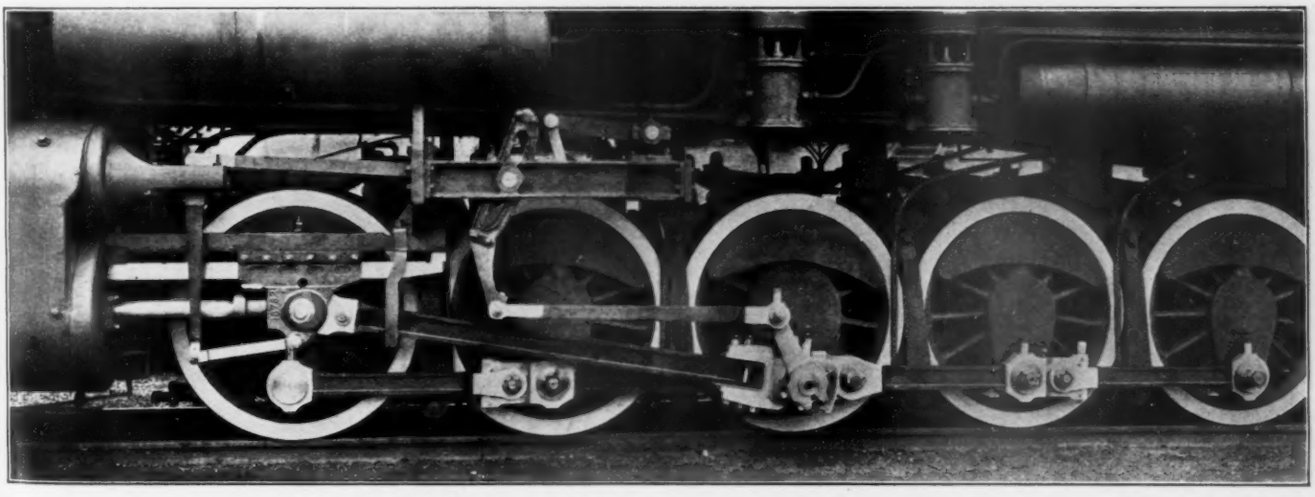


Fig 18—Running Gear of Chicago, Burlington & Quincy, 2-10-2 Type Locomotive

300,000 lb. The main drivers were several hundred pounds light as to counterbalance, even in balancing the revolving weights, and two counterweight bobs weighing 1,500 lb. each had been placed on the main axle between the boxes. This made the dead weight on the main drivers excessive. The railroad company

asked the Baldwin Locomotive Works to design two locomotives of a duplicate order of ten engines without the counterbalance bobs on the main axle, and to use alloy steel for the piston rods, connecting rods, stub straps, pins and eccentric cranks. The pistons and crossheads were to be lightened as much as possible. It was decided to use nickel-chrome steel, annealed, with an ultimate strength of 100,000 lb. per square inch, a yield point of 70,000 lb. per square inch and an elongation of 23 per cent.

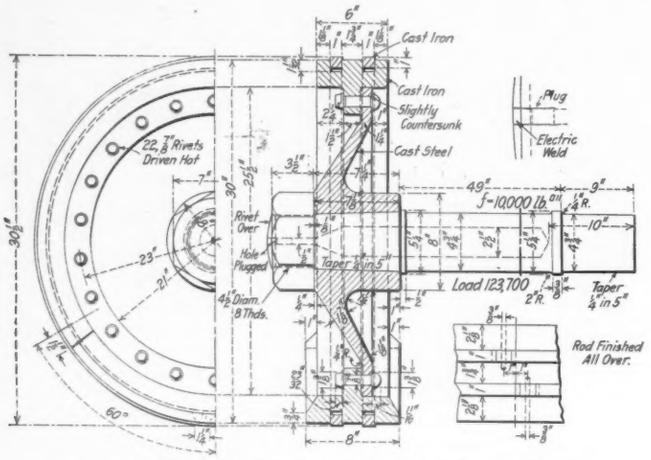


Fig. 19—Piston and Rod for Burlington Locomotives

This was found impossible to obtain. Nickel-chrome carbon steel, oil tempered, was finally used and had the following properties:

Carbon	0.38 per cent	Ultimate tensile strength,	96,000 lb. per sq. in.
Manganese	0.50 per cent	Yield point	70,000 lb. per sq. in.
Silicon	0.026 per cent	Ultimate compressive strength (assumed)	60,000 lb. per sq. in
Nickel	1.27 per cent	Elongation	25 per cent
Chrome	0.28 per cent	Reduction in area	62 per cent

The piston and crosshead were made of 0.4 carbon cast steel, carefully annealed, with an ultimate tensile strength of 80,000

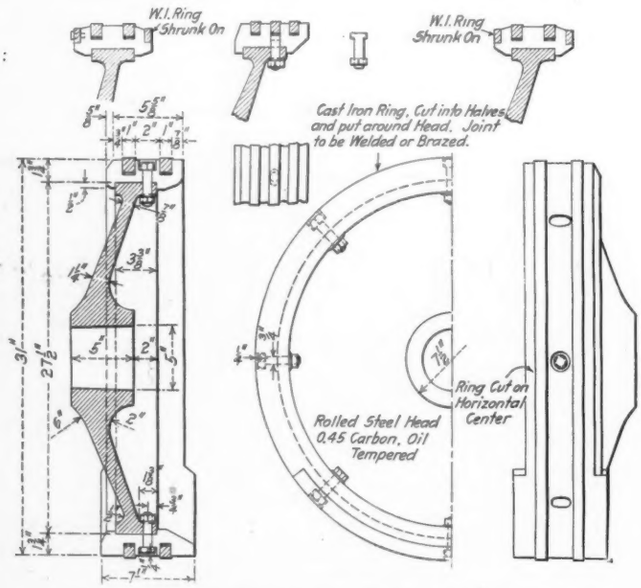

W.I. Ring Shrunk On
W.I. Ring Shrunk On
Cast Iron Ring, Cut into Halves and put around Head. Joint to be Welded or Brazed.
Ring Cut on Horizontal Center
Rolled Steel Head 0.45 Carbon, Oil Tempered

Fig. 20—Burlington Piston Redesigned

lb. per sq. in., yield point 50,000 lb. per sq. in., and elongation 22 per cent. An idea of the appearance of these parts may be obtained from Fig. 18. The results obtained in weight reduction are given in Table IX. The counterweight bobs were omitted from the main drivers and the weight at the rail on the main drivers was reduced from 67,000 lb. to 62,000 lb. The main wheels without any bobs were better balanced vertically by 35 lb. The forward, back and intermediate wheels have very much less excess weight, and the total weight of the reciprocating parts was reduced 16 per cent.

Fig. 19 shows the piston and piston rod. The piston is made

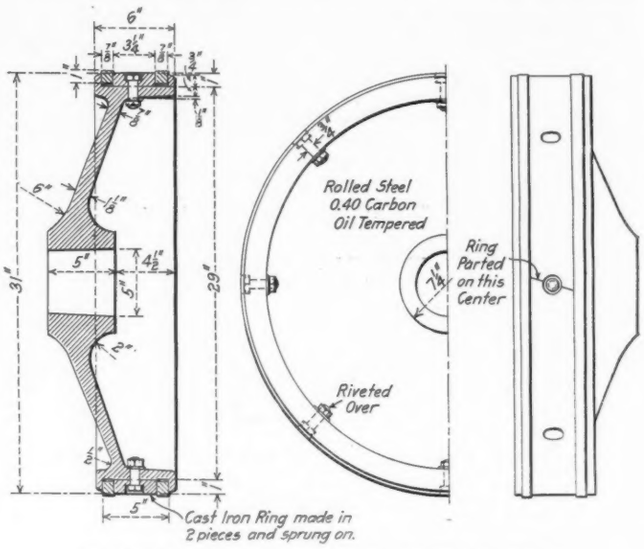

Rolled Steel 0.40 Carbon Oil Tempered
Ring Parted on this Center
Riveted Over
Cast Iron Ring made in 2 pieces and sprung on.

Fig. 21—Another Redesign of the Burlington Piston

of 0.4 carbon cast steel, annealed; a cast iron bull ring is used. The piston rod is of nickel-chrome steel, hollow-bored and then

Table IX—Saving in Weight in Reciprocating Parts of Burlington 2-10-2 Type Locomotives

Name of part	Weight, in lb., of Carbon steel parts	Nickel-chrome parts	Weight saved, lb.
Piston and piston rod	1,022	945	72
Crosshead	706	526	180
Main rod	1,305	1,035	270
Side rod on front pin	150	117	33
Side rod on intermediate pin	482	352	130

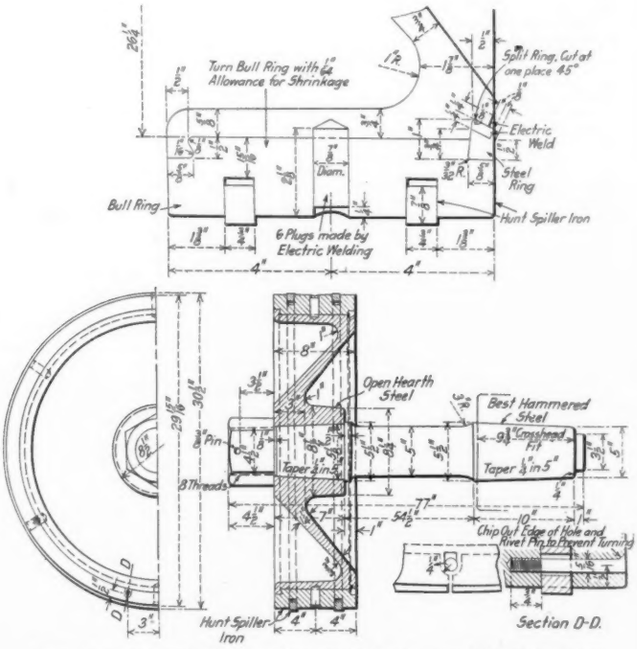

Turn Bull Ring with 1/64" Allowance for Shrinkage
Split Ring, Cut at one place 45°
Electric Weld
Steel Ring
Bull Ring
Hunt Spiller Iron
6 Plugs made by Electric Welding
Open Hearth Steel
Best Hammered Steel
Crosshead Fit
Taper 1/4 in 5"
8 Threads
Chip Out Edge of Hole and Rivet Pin to Prevent Turning
Hunt Spiller Iron
Section D-D.

Fig. 22—Pressed Steel Piston with Cast Iron Wearing Shoe

Side rod on main pin	718	577	141
Side rod on intermediate pin	476	388	88
Side rod on back pin	150	111	39
Main crank pin	360	325	35
Eccentric crank	160	125	35

oil-tempered, and an extension piston rod is not used, so that a cast iron wearing ring seemed necessary.

The piston shown in Fig. 19 is not as light as it could have been designed and ample strength still retained. Figs. 20 and 21 show this piston redesigned and considerably lightened. The piston rod is not to have an extension tail rod, and the piston is to be made of rolled open hearth steel of 0.45 to 0.50 carbon and oil tempered. The wearing shoe is of cast iron with lips on the outside; this ring will be made in one piece, then parted by one cut and sprung around the head and welded or brazed where it was cut. Eight ¾-in. bolts help to hold the shoe to the piston, although it is a question whether these are needed after the shoe is once put on and the ends brazed together.

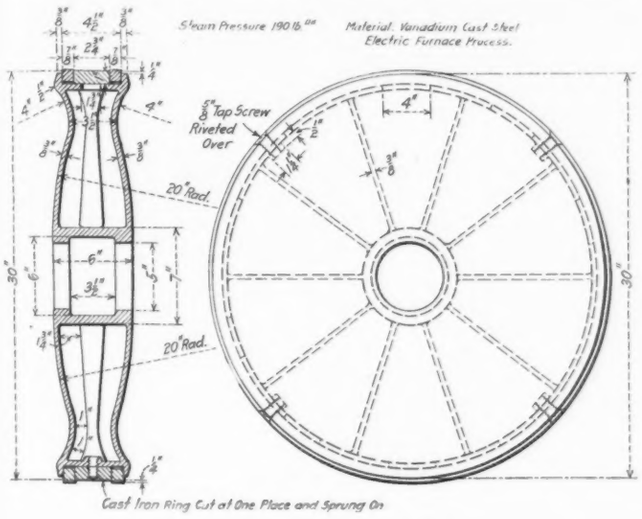


Fig. 23—Hollow Box Type Piston

Fig. 22 shows a pressed steel piston head 30 in. in diameter, that has a cast iron wearing shoe, held by a retaining ring. This is a light piston but is expensive to make and fit up.

Fig. 23 shows a 30 in. piston head of the hollow box type with a cast iron wearing shoe sprung in or cast on. This head is to be made of vanadium cast steel with an ultimate strength of 90,000 lb. per sq. in., and to withstand 190 lb. boiler pressure. This head, with only ⅜ in. walls, is to be cast by the electric furnace process, and the manufacturers state that it is well within their possibilities. This piston, complete with rings, weighs only 250 lb.

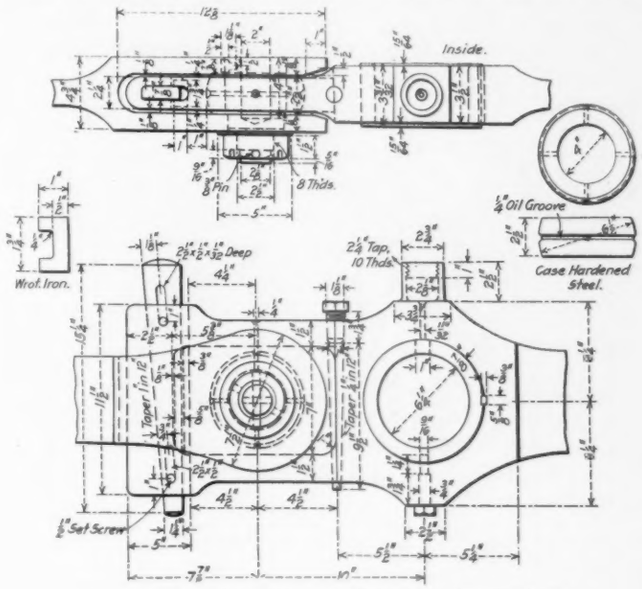


Fig. 25—Side Rod Stubs of Burlington Locomotives

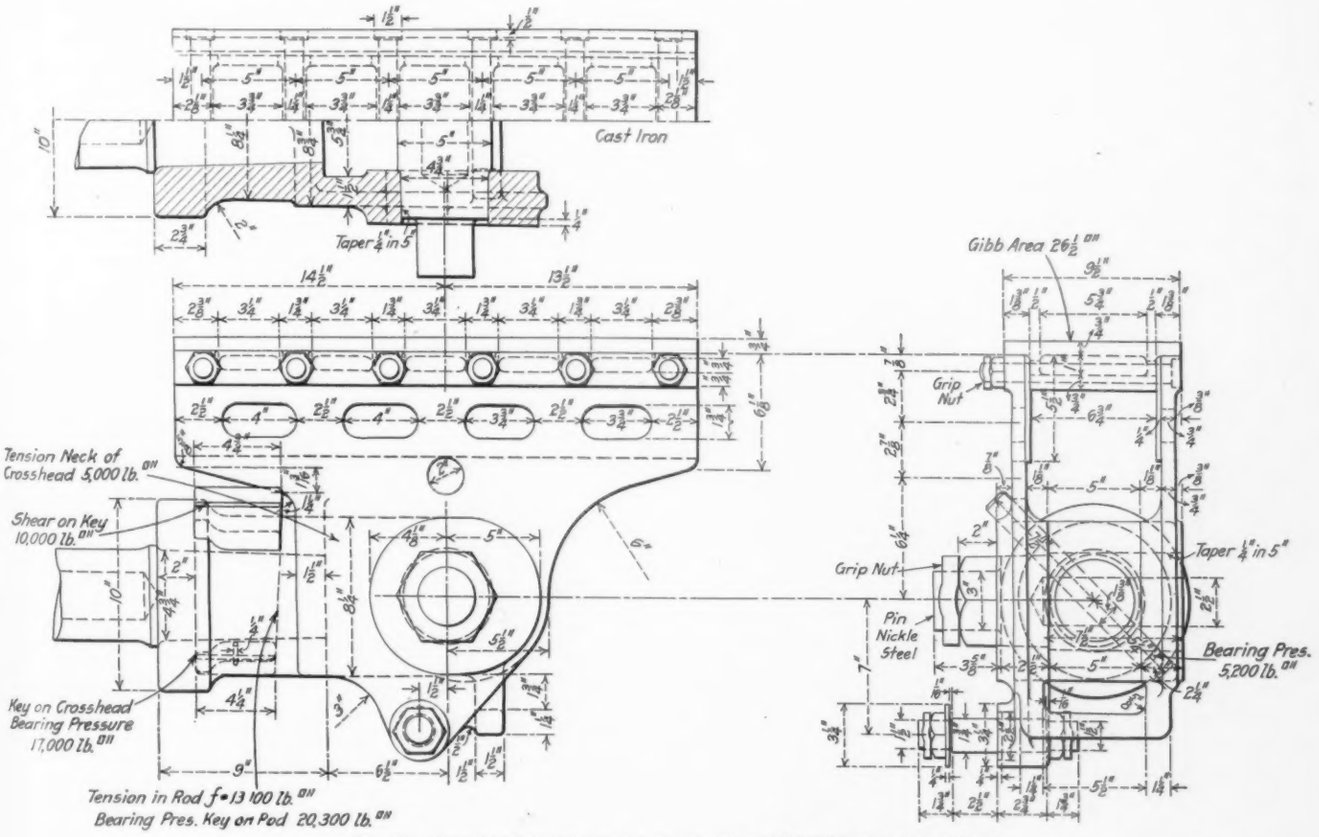

Cast Iron
Taper ¼" in 5"
Gibb Area 26½ G.N.
Grip Nut
Tension Neck of Crosshead 5,000 lb. G.N.
Shear on Key 10,000 lb. G.N.
Grip Nut
Taper ¼" in 5"
Pin Nickle Steel
Bearing Pres. 5,200 lb. G.N.
Key on Crosshead Bearing Pressure 17,000 lb. G.N.
Tension in Rod f = 13 100 lb. G.N.
Bearing Pres. Key on Pod 20,300 lb. G.N.

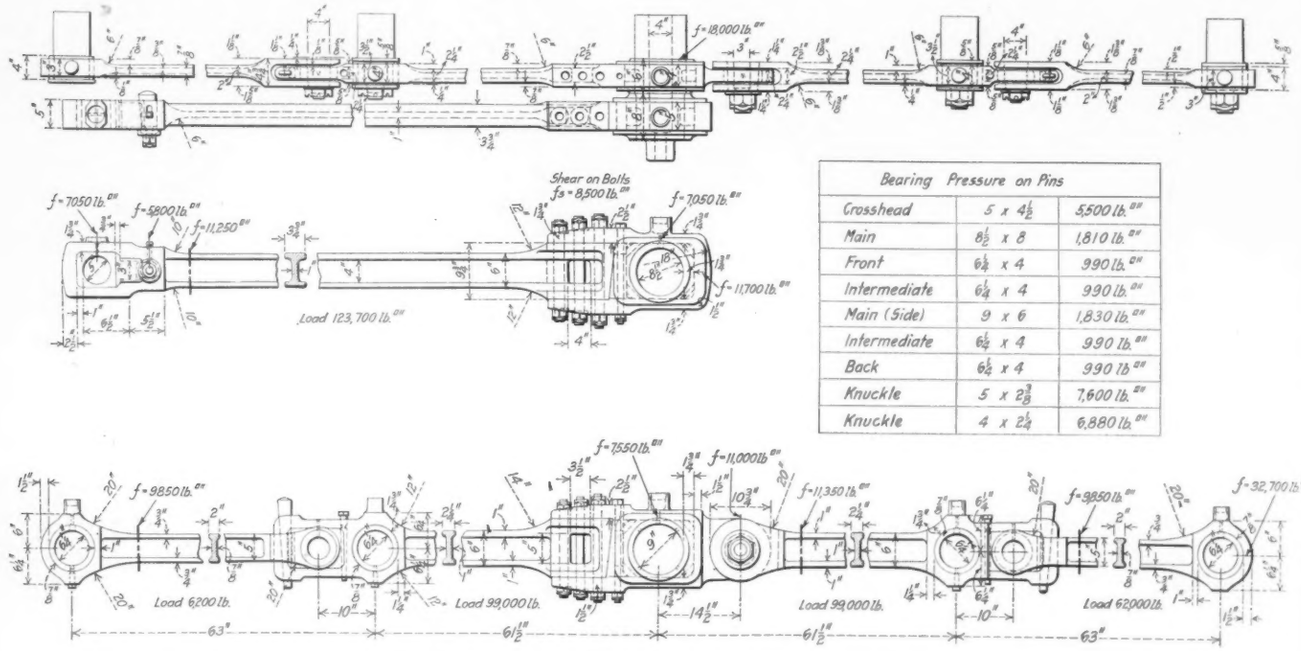
Fig. 24—Crosshead Used on the Burlington 2-10-2 Type Locomotives

Fig. 24 shows the crosshead of the Burlington engines. This is made of .4 carbon cast steel annealed, the ultimate tensile strength

being 80,000 lb. per sq. in. A cast iron wearing gib is used. The Laird type of crosshead with two bar guides was decided on, as for large freight engines it was found that this was the lightest type obtainable. Many railway men are not in favor of this type of crosshead, but it has been successfully used on many freight and passenger locomotives, some of the freight locomotives being of very high power. On many European railways it is standard, especially on passenger engines.

It will be noted that a small lug has been cast on for the pin

The connecting rods of the Burlington locomotives are shown in Fig. 26. I section main and side rods have been used and the bearing pressure on all the pins kept fairly low. The main side rod connection is of the strap type with wedge adjustment, this arrangement being used in order to keep the bearing pressure low on this pin. As the diameter of the crank pin increases and the periphery speed of the brass on the pin also increases, the bearing pressure on these large pins should be kept even lower than has been done in this case. The stub straps are of



Bearing Pressure on Pins		
Crosshead	5 x 4½	5,500 lb.
Main	8½ x 8	1,810 lb.
Front	6½ x 4	990 lb.
Intermediate	6¼ x 4	990 lb.
Main (Side)	9 x 6	1,830 lb.
Intermediate	6½ x 4	990 lb.
Back	6¼ x 4	990 lb.
Knuckle	5 x 2⅜	7,600 lb.
Knuckle	4 x 2¼	6,880 lb.

Fig. 26—Connecting Rods of the Burlington Locomotives

for the combining lever. It was decided to do this because it was thought that the crosshead pin had enough to do without driving the valve motion, and also because the length of the combining lever required this particular location. A large crosshead pin has been used, and ample bearing surface provided for the pin in the crosshead itself.

The stresses on the various sections are given in table X,

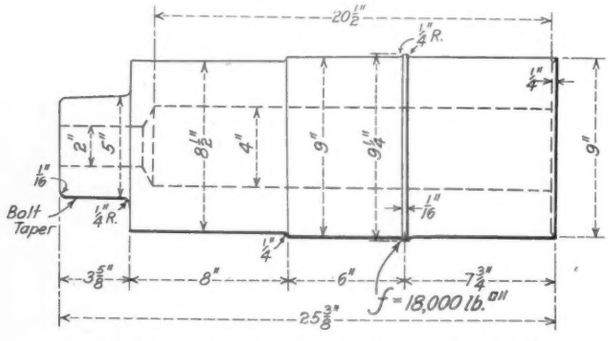


Fig. 27—Main Crank Pin of Burlington Locomotive

based on a load equal to the area of the piston multiplied by the full boiler pressure. The usual allowable unit stresses are given in the second column.

TABLE X—STRESSES IN CROSSHEAD OF BURLINGTON 2-10-2 TYPE LOCOMOTIVES

Section	Lb. per sq. in. Stress	Usual allowable stress
Shear on key	10,000	9,000
Tension in rod through keyway	13,100	10,000
Tension in neck of crosshead through keyway	5,000	3,500
Crushing of key on rod	20,300	17,000
Crushing of key on crosshead	17,000	15,000
Bearing pressure, pin on crosshead	5,200	5,500
Compression in main shank of piston rod	10,000	8,000

nickel-chrome, oil-tempered steel and are light. The stubs on the main pin, although of the strap type have had every pound of unnecessary weight removed and are very light in relation to the work performed. The stresses in the different sections are given in table XI, based on the main rod load equal to the area of the piston multiplied by the full boiler pressure and a proportional load on the side rods, 50 per cent on the front and back rods and 80 per cent on the two middle rods.

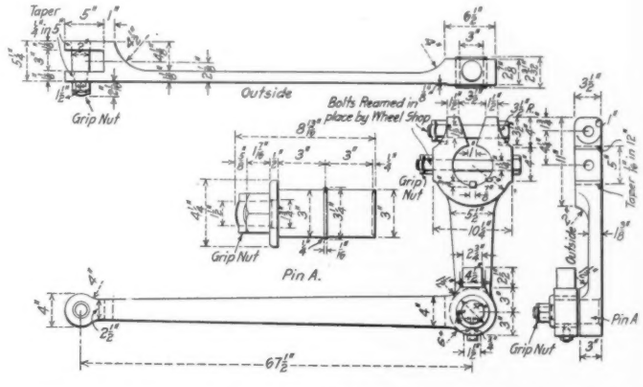


Fig. 28—Eccentric Crank and Rod of Burlington Locomotive

The intermediate knuckle pin is large in diameter and has ample wearing surface. The front and back knuckle pins are of the ball pin type. This type of stub is clearly shown in Fig. 25. When this style of ball pin is used, it is the writer's belief that greater stresses may safely be used in the rods. This style of pin has been running some years and has given every satisfaction.

The I sections of both the main and side rods are of a design

not much used by other American designers. The rods are narrow and heavy webs are used. It is thought that the narrower the original slab from which the rod is made the sounder every part of it is forged; then instead of cutting away and leaving only a very thin web in the middle of the rod, which is the least worked part of the steel, enough metal is left to provide a substantial and solid web.

Table XI—Stresses in Main and Side Rods of Burlington 2-10-2 Type Locomotives

Section	Stresses, lb. per sq. in. Alloy steel	Carbon steel, Not heat treated
Main rod, I section	11,250	8,000
Crosshead stub strap	7,050	6,000
Crosshead stub strap at set screw	5,800	6,000
Main rod stub, tension	8,500	8,000
Main rod stub, bending	11,700	14,000
Side rod (front and back) I section	9,850	8,000
Side rod (intermediate) I section	11,300	8,000
Stub (front and back) eye, tension	6,000	6,000
Stub (front and back) eye, bending	32,700	20,000
Main side strap, tension	7,500	6,000
Main knuckle eye, tension	11,000	6,000
Intermediate stub eye, tension	7,900	6,000
Intermediate knuckle eye, tension	7,500	6,000

It must not be thought that this style of rod is any heavier than the slimmer and wider one, because each has the same stress and therefore the same cross-sectional area. As a strut in compression, where the ratio of length to the least radius of gyration $\frac{l}{\rho}$ — does not exceed 160, actual tests on full sized sections have shown that this type of rod is just as strong as the wider and slimmer one. It is the writer's belief that this type of rod will withstand the varied stress conditions better than any other section.

The main crank pin, Fig. 27, is of nickel-chrome steel, hollow bored and then oil tempered. The fiber stress in this pin in bending is not high considering the fine quality of the steel. As a matter of fact the outside dimensions of the pin were determined by the bearing pressure. A larger hole could have been bored out of this pin and the fiber stress still kept within safe limits.

The eccentric crank and eccentric rod, Fig. 28, were lightened, but not as much as they might have been. By careful attention to the driving wheel design—the style of rim, the spokes and hub—some weight was taken off the unbalanced hub portion and a few pounds added to the counterbalance where this weight counted most.

Reference has been made to the difficulty of keeping the bearing pressure low on large crank pins on account of the periphery speed of the brass increasing as the diameter of the pin is increased, and in this connection Fig. 29 shows another style of main stub and brass. The Chesapeake & Ohio had great difficulty in keeping the main pins cool on their Mountain type locomotives, which originally had the usual strap and wedge stub. This new stub is solid, with no key adjustment and a steel bushing is pressed into the solid end and held by steel plugs at the top and bottom. The brass is a loose bronze ring and revolves on the pin and in the bushing; this reduces the velocity of the brass by one-half. The pin is oiled by a series of holes in the brass, grease plugs, top and bottom, being used. J. R. Gould, superintendent of motive power of the Chesapeake & Ohio, states that this style of stub has been in operation two years and has given satisfaction.

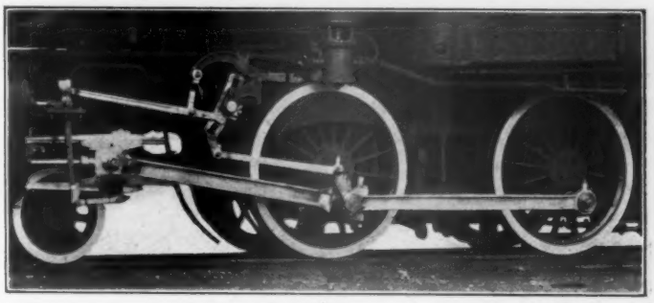


Fig. 30—Running Gear of Philadelphia & Reading, 4-4-0 Type Locomotive

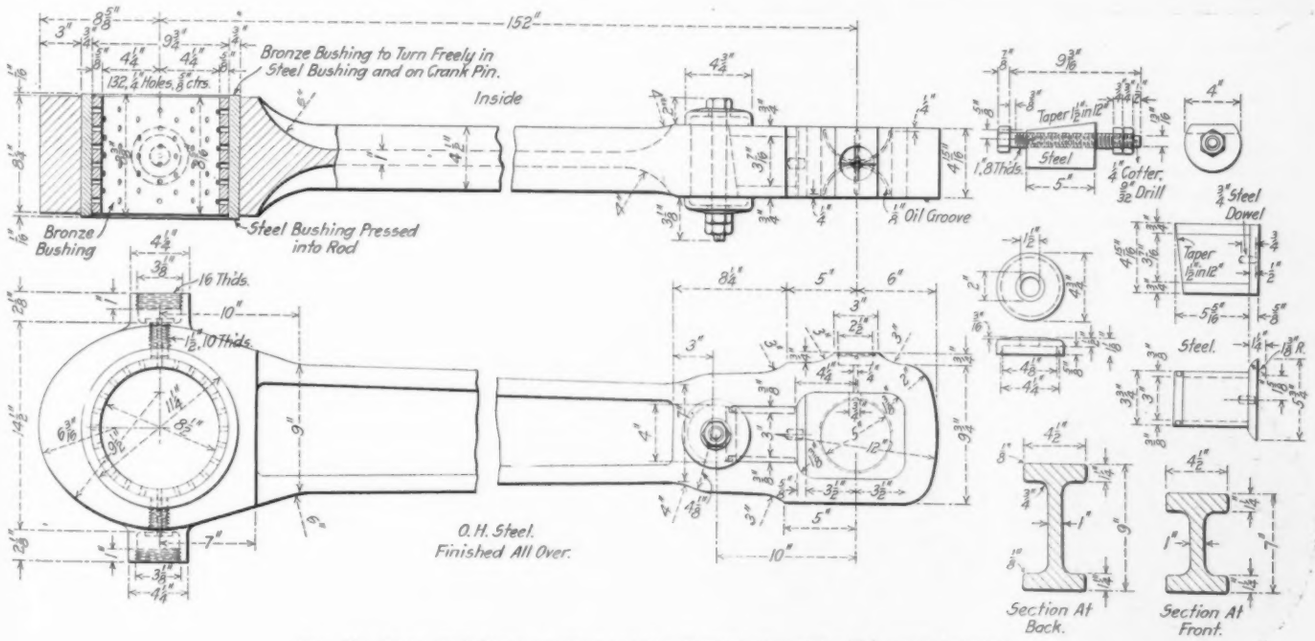


Fig. 29—Main Rod Used on Chesapeake & Ohio Mountain Type Locomotive

Fig. 30 shows a Philadelphia & Reading 4-4-0 type passenger locomotive, ten of which were built by the Baldwin Locomotive Works in 1914 to the company's designs. It is believed that these are the heaviest eight-wheel engines ever built. Special attention was given to the design of the reciprocating and revolving parts and all the valve motion parts. It is not intended to go into their design in detail, but the illustration shows clearly

that all these parts, and especially the valve motion work, are light.

AN X-RAY INSPECTION OF A STEEL CASTING*

BY DR. WHEELER P. DAVEY
Research Laboratory, General Electric Company

It has always been true that as soon as a new tool is perfected unsuspected applications of that tool rapidly develop. This has been especially true in the case of the Coolidge X-ray tube. Possibly the question of observing the "pipe" in a steel ingot by the use of the X-ray, thereby being able to determine just where the ingot should be cropped, may seem still somewhat removed, at least in so far as commercial applications are concerned. There is no inherent impossibility in the process however. The case now being described is a long step in this direction. It is the object of this article to describe in detail what has already been done in the way of an X-ray examination of a certain steel casting of which suspicion had been aroused as to its homogeneity when in the machine shop.

Fig. 1—Radiograph of Steel Casting Showing a Blow Hole Below the Surface. The Circle Shows Where the Button Was Removed

The original casting was 2½ in. thick and weighed about a ton. When received at the Schenectady works of the General Electric Company it had been machined down to approximately the desired shape and thickness. The amount still to be taken from the faces was not more than ⅛ in., and in some places was only 1/16 in., but when this was removed it was found that some small imperfections had been cut into. These extended over an area about 5 in. long and 1½ in. wide. The mechanical department at once chiseled away a part of the surface at this point, and then sent the casting to the research laboratory to determine if, by means of an X-ray examination, it might be possible to reveal still other hidden blow holes or imperfections.

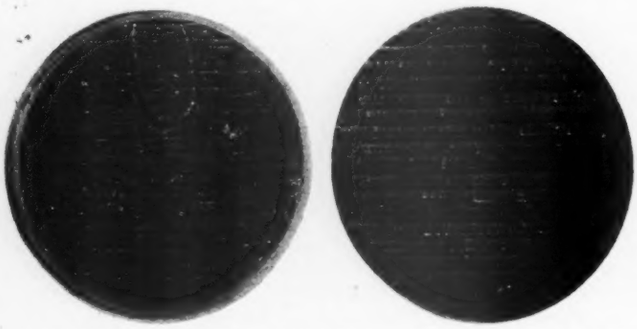


Fig. 2—Machined Surfaces of the Button Removed from the Point Shown in Fig. 1

A Coolidge tube especially made for use on high voltages was set up in front of that part of the casting where the imperfections had been found. An 8-in. by 10-in. Seed X-ray plate was mounted immediately behind the casting and the plate was backed by a large sheet of lead. The distance from the source of X-ray to the plate was 20 in. The tube was excited by an induction coil with a mercury-turbine interrupter. The current through the tube was 1.25 milli-amperes and the potential across the terminals of the tube corresponded to that sufficient to break down a 15-in. spark gap between needle points. The X-ray plate was exposed two minutes. At the place where the radiograph was taken, the finished casting was about 9/16 in. thick. After a radiograph had been obtained at the point where the imperfections were discovered, the casting was moved 8 in. and another radiograph made. In this way a number of exploratory radiographs were taken through different points of the casting.

All the radiographs thus taken showed plainly the tool marks on the surface of the casting. All but one showed peculiar markings, which were of such shape as to strongly suggest that they were indeed the pictures of holes in the interior. A circular piece, 1 in. in diameter, was punched from the casting at a point where one of the radiographs indicated that a blow hole should be found. A reproduction of this radiograph is shown in Fig. 1, and the point at which the punching was taken is indicated by the circle. An examination of Fig. 2 shows that the surfaces of the casting were entirely free from blow holes at the point where the button was removed. Fig. 3 shows the ends of the hole in the button.

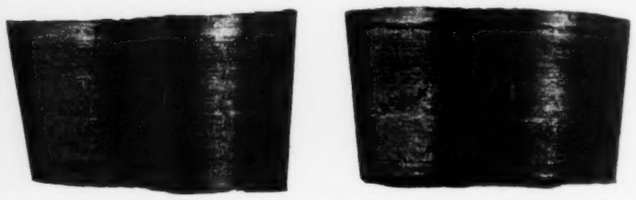


Fig. 3—The Ends of the Blow Hole Passing Through the Button

This has proved, then, that with the proper X-ray exposure, blow holes or cavities may be disclosed in apparently solid metal of considerable thickness. A careful comparison of the X-ray photographs and the button photographs leads to the conclusion that very small air inclusions are made visible; and the fact that the tool marks are plainly visible on the X-ray plate confirms this.

*Abstract of an article appearing in the January, 1915, issue of the General Electric Review.

Relative Efficiency of Steam, Gas and Oil Engines.—Roughly stated, a first-class modern steam engine utilizes about 12 per cent of the available heat in the coal, resulting in, say 1.6 to 1.7 lb. of fuel per b.hp.hr. during a week's work of 55 hours. If the boilers are to be fired by producer gas, for which purpose slack and dust can be used, then each brake horsepower will require about 2 to 2.2 lb. of coal. Internally fired gas and oil engines are approximately twice as efficient as steam engines, which means that they utilize about 25 per cent of the available heat. Crude oil being 37 per cent better than good ordinary coal, oil engines should use only about three-eighths as much oil as the coal mentioned above, say about 0.6 lb. per b.hp.hr. Then, however, as there are no boiler radiation losses over night, a material saving results and the oil consumption per week of 55 hours may be about 0.5 lb. per b.hp.hr. Petrol and similar internal combustion engines would require about 0.4 lb. per b.hp.hr. Gas engines have also the same efficiency as oil engines, but as there is a loss of about 20 per cent in the producers, if these work day and night, and another loss of quite 10 per cent if they have to stand idle over night, the efficiency of gas engines is only about 40 per cent better than that of first-class steam engines.—*Power.*

CAR DEPARTMENT

THE DEFECTS OF MODERN BOX CARS AND THEIR REMEDIES*

BY ROBERT N. MILLER
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The proper strengthening of box car underframes is in itself a subject worthy of serious consideration, owing to the ever increasing demands placed upon the underframe. As a result of the introduction of larger and more powerful locomotives, the cars of weaker design have been gradually retired to the cripple shop to be reinforced or, where damage has been too great, to be scrapped. With this gradual elimination of the weaker type and the substitution of still stronger types has arisen the question as to what shall be considered a proper standard for the strength of box cars. This question is one of great import, for in it are involved questions concerning first cost, depreciation and maintenance, and interlocking with these the questions pertaining to durability, protection of lading and the cost of hauling the dead weight over the line.

Aside from the question of first cost of equipment can be considered that phase of economical construction in which more stress is laid upon durability, maintenance and protection of lading than upon first cost, depreciation and cost of haulage of dead weight and therefore on the basis of equal revenue ton-miles we could consider the extremely heavy construction on one side of the balance against the extremely light construction on the other side, with the most economical type of construction somewhere between the two. After all, railway operation is a matter of dollars and cents and in these days of rigid economies and retrenchments it should be the aim of managements to safeguard the future by investing only in such forms of equipment as give the lowest final cost and not, as is more often the case, in designs which are low in first cost but high in maintenance and depreciation.

It is of course to be admitted that in cases of new types of construction figures are not always available showing the cost of maintenance or of actual depreciation of these newer types, due to wear and tear, and therefore it may be argued that at best we can but resort to the method of cut and try in determining which type of construction is the more economical. However, by a constant study of yearly costs of depreciation, maintenance and haulage of dead weight, based on revenue ton-miles made by the car, we can soon observe whither the drift of costs is carrying us. This is, of course, assuming that no one type of car has been favored to the detriment of the others.

With this end in view, after a series of observations covering a period of several years of the performance of various types of construction used in freight equipment, the writer concludes as follows:

UNDERFRAMES

The average freight car of today, whether of high or low capacity, does not possess an underframe of sufficient strength to withstand repeated stresses due to loading of the car and due to end shocks or jerks received in train handling or in hump yard service. In order to prove this we have only to visit the cripple yard to observe the more common repairs made there. Many center sills can be found which, while they are of ample section area in the gross to withstand end shock, still, due to defective design in the distribution of this area, or in the splicing at the draft sills or at the riveting of the tie or web plates of the body bolsters or crossbearers to the center sills, have been so badly mutilated with rivet holes as to render them practically useless as tension members capable of resisting the jerks incident to the starting of trains or to undesired quick action from the rear of the train when moving at slow speeds.

That center sills are often weaker as tension members than as compression members can be seen by inspection of the many forms of so-called steel center sill cars, in which the center sill can be considered as a form of the continuous draft gear officially declared obsolete. In this case one may find as high as 25 to 30 per cent of the full section of the sill removed through rivet holes for either coupler lugs or tie and web plates at the bolsters or crossbearers, or at the draft sill splices to the center sills. Not only has the net area of the center sill been seriously reduced, but what is of greater consequence, the resisting section modulus of the center sill has been impaired to a far greater extent. It can therefore be seen that the matter of the most efficient type of riveting arrangement is one which warrants careful attention in order that the center sill sections shall be most efficient.

Again, where center sill construction employs draft sill splices to center sills at some point between the end sill and the body bolster, the section areas of the draft sills are often purposely made less than that of the center sill proper so as to localize the weakest member of the center sill construction. However, it appears that in the attempt to safeguard the center sill itself, the draft sills have been made entirely too light, with a result that due to repeated shocks in both alternate tension and compression the draft sill fatigues, weakens and finally fails along the path of least resistivity, namely, at the rivets. Inasmuch as the great majority of draft sill splices are of the chain riveted type it is believed that a decided improvement can be affected at this point by the use of the staggered form of riveting. This would also in a way apply to the riveting found at the bolster and crossbearer connections to the center sills.

Where underframes are spliced at the draft sills the splice riveting should be given particular attention with a view to a design such that the section modulus of rivet areas or the rivet shearing moment shall be at least equal to the net resisting moment or section modulus of the draft or center sill. A study of the splicing commonly found at draft sills develops that many are weak at this point, so that while the shearing areas of the rivet sections appear sufficient for a direct shear, yet they are entirely inadequate to resist shear due to combined eccentric and direct draft gear loads, with a result that those rivets less favorably located with respect to their neutral axis are the first to fail, either by working loose, shearing or tearing out. The fact that these rivets pound loose proves the rivet section of improper design.

It has been recommended before the Master Car Builders' Association that for cars built after 1913 the area of the center sills should exceed 24 sq. in. and that the ratio of end stress to strain should not exceed 0.06, as shown by the formula:

$$0.06 > \frac{1}{A} + \frac{X}{S_m}$$

Where A = center sill section area;
X = eccentricity of resultant draft gear load about the neutral axis;
S_m = section modulus of sill section.

This formula is directly applicable to constructions where

*Entered in the car department competition which closed October 15, 1914.

the center sill is not used to support the car lading, as would be the case in the true side frame types of construction. However, where the center sill is, in addition to acting as a column member, subjected to a transverse bending due to the nature of the loading, the additional stress due to the maximum transverse bending moment at any point under consideration should also be included; so that where M represents the resultant maximum bending moment due to loading, being plus or minus, according as it is in the same clockwise direction, or not, as the draft gear bending moment, then the equation becomes:

$$0.06\ ES > \frac{M}{S_m} + \left(\frac{1}{A} + \frac{X}{S_m}\right) ES$$

where ES is the value of end strain or draft gear load.

The question as to whether the net value of A (sill area) and S_m (section modulus) are to be used depends entirely upon the matter of the direction of the maximum bending moment and the direction of the force ES. If the indications are that the section is more unfavorable to a tension force ES, then of course the net values are to be used, otherwise full section values could be employed. As a matter of fact, however, the writer believes it better to err on the side of net areas rather than to attempt to decide just where tension and compression cease in the section. Under an end load ES, equal to 400,000 lb., the maximum permissible working fibre stress in the center sill would be 24,000 lb. per sq. in. This fibre stress is equivalent to a factor of safety of about two when based on the elastic limit of the material used.

DIAGONAL BRACING OF UNDERFRAMES

The present tendency in the bracing of body bolsters and crossbearers against longitudinal movement at the outer extremities seems to be toward the elimination of all diagonal braces except those from the outer ends of the end sill to a point forward of the body bolster. These have been retained in order to permit poling of the car through the pole pockets and also to reinforce the underframe against serious damage in the event of the car being cornered. This elimination of diagonal bracing can be considered as satisfactory from an engineering point of view, provided bolsters and crossbearers each have sufficient lateral rigidity to bear their portion of impact loads along the line of the underframe without distortion, and with this in mind each crossbearer or bolster should be so designed that the resultant fibre stress due to vertical bending under direct loading, plus that due to lateral bending through inertia of loading, does not exceed a predetermined value of 20,000 lb. per sq. in. Therefore, not only should the section moduli of the crossbearers and bolsters be considered with reference to vertical bending, but they should also be considered with reference to lateral bending, so that:

$$\frac{M}{S_x} + \frac{K\,M}{S_y} = \text{or} < 20{,}000 \text{ lb. per sq. in.}$$

Where M = the vertical bending moment on each arm of crossbearer due to lading;
K = inertia factor due to sudden change in speed of car;
S_x = section modulus of net section of crossbearer with reference to the horizontal axis;
S_y = section modulus of net section of crossbearer with reference to the vertical axis.

The factor K can be derived as follows:

Let V_1 = initial speed of moving body in miles per hour;
V_2 = final speed of moving body in miles per hour;
d = distance, in feet, in which the speed has been changed from V_1 to V_2;
K_1 = average force acting upon one pound of the moving body to change the speed from V_1 to V_2 in distance d;
$K = 2\ K_1$, or value of a force ranging from zero to a maximum K, with average equal to K_1.

Then on the basis of each pound of moving weight:

$$K_1 d = \left(\frac{V_1^2 - V_2^2}{2g}\right) \times \left(\frac{22}{15}\right)^2 = 2.15 \left(\frac{V_1^2 - V_2^2}{2g}\right)$$

$$\text{or } K_1 d = (V_1^2 - V_2^2) \times .0334$$

$$K d = 0.0668\ (V_1^2 - V_2^2)$$

$$= 0.07 \times (V_1^2 - V_2^2), \text{ approximately,}$$

$$\text{or } K = 0.07 \left(\frac{V_1^2 - V_2^2}{d}\right)$$

By means of diagonal bracing to the extremities of the crossbearers to take care of inertia loads in either direction, the crossbearer sections need then only be designed for vertical bending with the diagonal ties or struts to resist the lateral bending, in which case the net section of the diagonal tie as a tension member can be shown as:

$$\text{Area} = \frac{K\,M}{20{,}000 \times l \cos \alpha}$$

Where K = inertia factor;
M = vertical bending moment due to load;
l = length of crossbearer arm in inches;
α = angle which the diagonal makes with the center sill.

In cases where the diagonal is used as a strut the section of the strut should be determined from the column formula:

$$\frac{K\,M}{l \cos \alpha} = \frac{20{,}000 \times A}{1 + \dfrac{l^2}{36{,}000\ r^2 \sin^2 \alpha}}$$

In which r = least radius of gyration of strut section.

The use of diagonal members to brace the crossbearers also subjects the latter to an additional direct tension or compression of:

$$\frac{K\,M \operatorname{Tan} \alpha}{l \times A}$$

This should be combined algebraically with the stresses due to vertical bending and the final resultant fibre stress should not exceed the 20,000 lb. limit.

CENTER SILL CASTINGS AND DETAILS

Where sills or members are coped out to afford clearances for lever floats, piping, etc., the sections at these points should be designed to give proper equivalent section moduli and owing to the frequency of failures at these points particular attention should be paid to these structural details. Castings used as fillers or reinforcement over the center plates should be designed to meet shocks due to the inertia of trucks, as well as to afford reasonable access for riveting, so that the center plate can be firmly secured to the underframe, thereby eliminating one of the most prolific causes of cars being thrown off center or center sills damaged through lack of proper bearing upon the center plates.

The draft sill members of center sills should also be securely tied at the top and bottom of the sills and especially back of the rear draft lugs, to prevent spreading of the draft sills under the draft gear loads.

END SILLS

The end sill member has received very little attention and many cars can be seen in daily service where it is so coped out at the center or draft sill as to render it well nigh useless as a load resisting member. It is believed, where circumstances permit, that end sills should be superimposed upon the center sills so as to render them most efficient in resisting cornerwise blows and also to resist those inertia loads coming from the end reinforcement members of the body end framing.

SIDE AND END FRAME

Where a steel side frame is used the members should be designed to meet not only stresses due to the dead weight of the car body and the car loading, but also the horizontal loads due to the inertia of the various car frame members and the lading. Especial attention should be given to the riveted connections of the frame members so as to obtain

connections of maximum efficiency for the loads to be sustained. The matter of lateral pressure or bending on the members of the superstructure should be considered with respect to the various commodities to be carried in the car. This lateral pressure warrants particular attention at the end reinforcement members, for one can observe unlimited instances where these end members have been designed entirely too light or weakened through cutting out for clearances, such as for uncoupling attachments, with the result that the end of the car soon assumes a spherical contour due to the effect of load shifting.

In connection with this matter before the Master Car Builders' Association it has been further recommended that end reinforcement members (not including corner posts) should have a section modulus equal to $(15 \text{ in.})^3$ at a point 2 ft. above the car floor, or practically equivalent to four 7/16 in. by 4 in. Z-bars. It has been further noted that such designs as have end reinforcement equivalent to the above recommendations experience very little trouble from bulged-out ends and this in itself should be ample indication that the recommendation is sufficient to meet present-day requirements.

Side frames at the door openings should be of sufficient strength in both top and bottom chord members to resist the combined stresses due to transverse bending and direct load and with the corners of the opening thoroughly gussetted to prevent distortion of the rectangular opening. When a car is provided with large end doors, as in those built for automobile service, special attention should be given to the locking attachments of these doors, so as to provide a removable type of end reinforcement of ample strength to resist such load shifts as are to be met in grain service.

ROOFS

When wooden frame cars were in more general use than at present the design of roof was such as would permit of a certain degree of flexibility, so as to accommodate itself to the weaving or twisting action of the car body while rounding curves or passing over uneven track. The feature of flexibility is still largely adhered to in steel side frame cars, and appears to have been more or less overdone in this case. Where steel side frames are employed and where they are of proper design to carry the loads imposed, one may observe no appreciable weaving of the car frame while passing over track inequalities; the whole car body or frame acts as a compact unit. In view of this fact, together with the difficulties inherent in sectional roofing, it would appear that a more logical type of roof would be that in which roof sheets (either rust-proof or anti-corrosion steel) are securely riveted together and to the roof carlines, thus tying the side frame and carlines into one rigid unit capable of withstanding mechanical strain. This would lead us to a type of continuous roof such as can be found on steel passenger equipment.

It is further believed that when the roads are sufficiently interested in the preservation of their steel equipment from corrosion, by the use of anti-corrosion paints or rust-resisting steels, we may expect to find a more general introduction of the all-steel car roof and finally the all-steel box car, which can be considered the "ultima thule" to which car builders are turning.

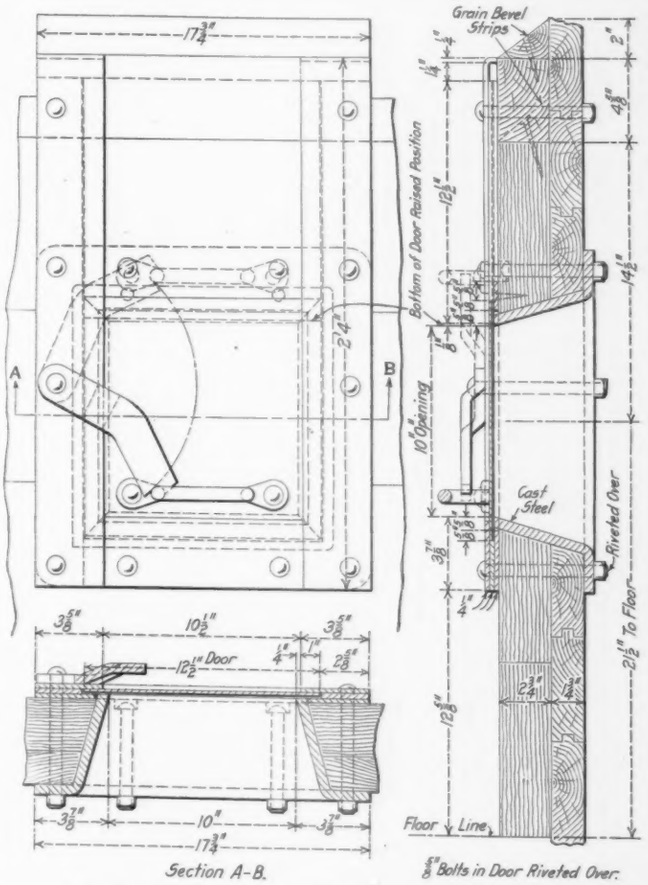
Conventions at San Francisco.—Up to the present more than 400 national and international congresses and conventions have chosen San Francisco as the 1915 meeting place, including 25 educational conventions.—*Iron Age.*

Psychology in Machine Design.—The man who remarked while standing in line waiting at a box office that he would rather walk two miles than stand five, expressed an important fact that we should keep in mind in designing machines. The human being must neither be unduly restricted in his freedom of action nor overtaxed with hard work.—*James Hartness.*

BOX CAR END DOOR

BY GEORGE E. McCOY

The lower rail end door illustrated below has recently been adopted by the Canadian Government Railways and applied to a number of 40-ton steel frame box cars. As shown in the engraving, the center line of the opening is located 21½ in. above the floor of the car and the door is operated inside the car. The door frame is a one-piece steel casting, the flange of which is secured to the outside by means of bolts



Lower Rail End Door, Canadian Government Railways

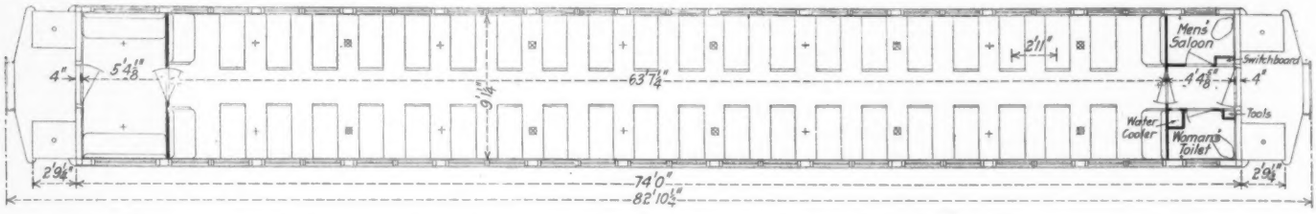
passing through the end of the car. The opening is tapered and is 10 in. square next to the door on the inside. The opening is closed by a steel plate which slides vertically in guides inside of the car. When closed the door is locked by means of a strut, the free end of which drops into position against the handhold near the bottom of the door and when open it is held up by the same device. Cars fitted with this type of door have been in service for some time with excellent results.

Block System on Haulageways.—In the main underground haulageway maintained by the Bunker Hill & Sullivan mine, through the Kellogg tunnel, two miles long to the shaft, an electric block signal system has been installed and has been in successful operation. This consists of a special circuit of colored lights strung along the tunnel throughout its main haulage length in one-mile sections, operated by the motorman through a lever that can be thrown conveniently at the end of each block. Red lights are used in one direction and green lights in the other, and the motormen are prohibited from entering a block carrying the opposite colored light until it is extinguished and shown to give them a clear track for a mile in length.—*Engineering & Mining Journal.*

GRAND TRUNK SUBURBAN COACHES

Steel Frame Construction Employed With Wood Reinforcement and Wood Finish; Weight 137,000 lb.

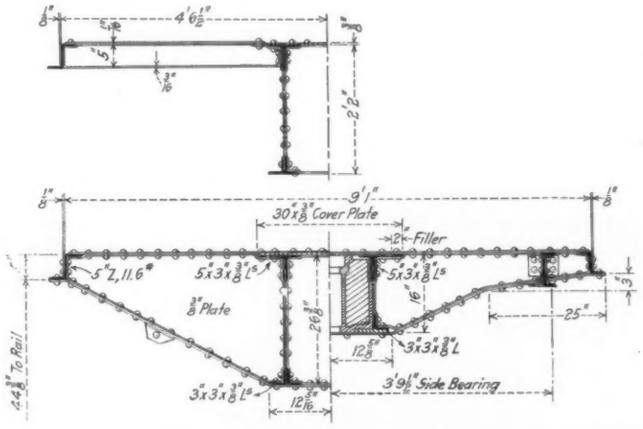
The Grand Trunk recently placed in service a number of suburban coaches, which are of particular interest from a number of standpoints. They are 83 ft. 3¼ in. long over buffers, 74 ft. long over body end sills and weigh complete, ready for service, with six wheel trucks equipped with rolled steel wheels, 137,000 lb.



Floor Plan of New Grand Trunk Suburban Car Which Seats 96 Passengers

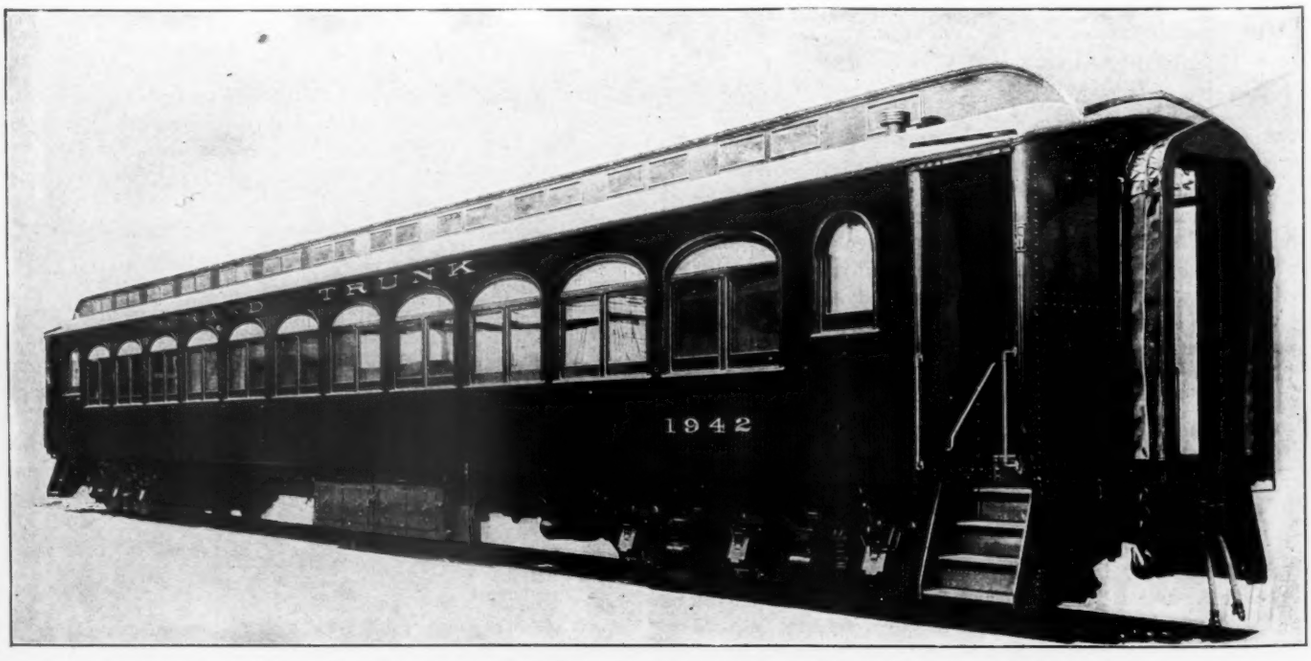
The framing is of steel construction with all steel vestibule, the interior and exterior finish being of wood. This construction is the result of much study and consideration, with the object in view of obtaining a construction which offered a maximum of safety and comfort to the traveling public, and a minimum expense to the railway company for maintenance. This problem seems to have been successfully solved by the adoption of a steel underframe and steel side framing, equivalent in strength to a steel car, in addition to which the car body and truck are locked together, so that the braking force is effective in stopping the car body as well as the trucks in case of derailment or collision. By the introduction of this truck and body bolster locking device,* and adopting all steel vestibules, the possibility of telescoping is believed to be practically eliminated. The locking device is designed to have a three-fold function, in case of wreck or derailment: First to prevent telescoping; second, to lower the center of gravity by adding the weight of two trucks (40,000 lb.) to the car body, preventing the body from turning over in case of derailment; third, the full effects of the air brake can be obtained under all conditions, even after a derailment, as each truck is held in position under the car.

By installing steam heat and electric light the car is rendered practically fireproof. The railway officers concluded after careful investigation that the passengers' wearing apparel, the

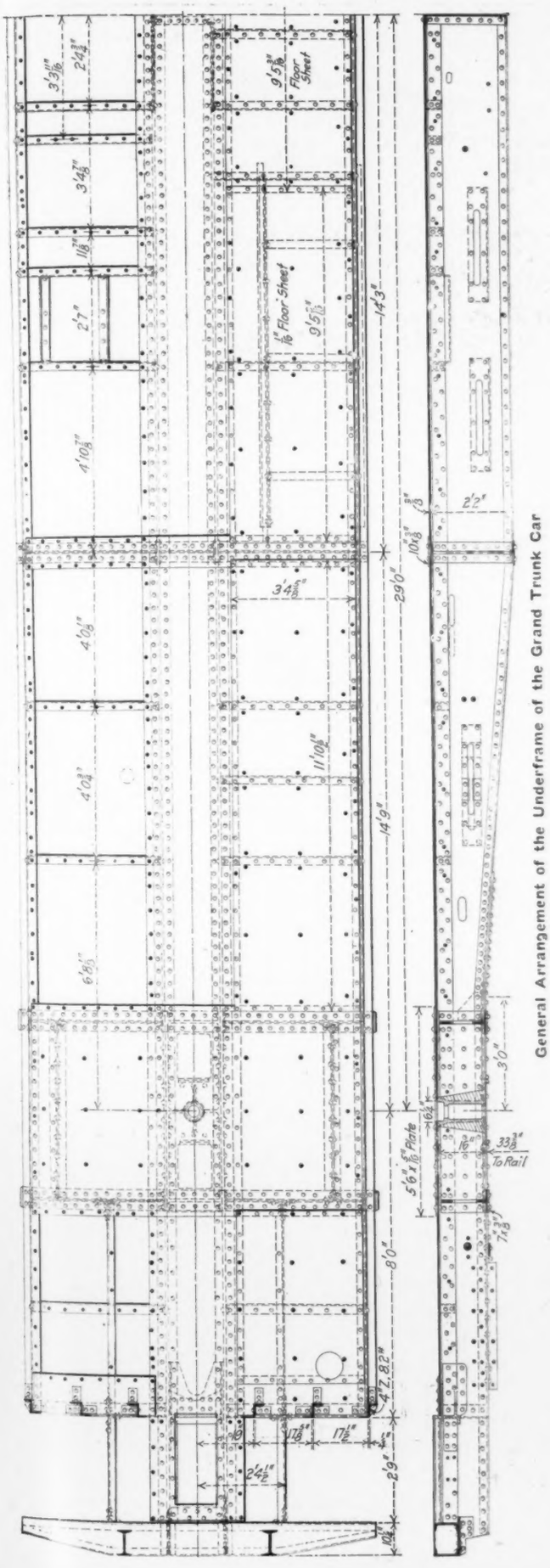


Cross Sections of the Underframe

*For description of this device see *American Engineer*, February, 1913, page 104.

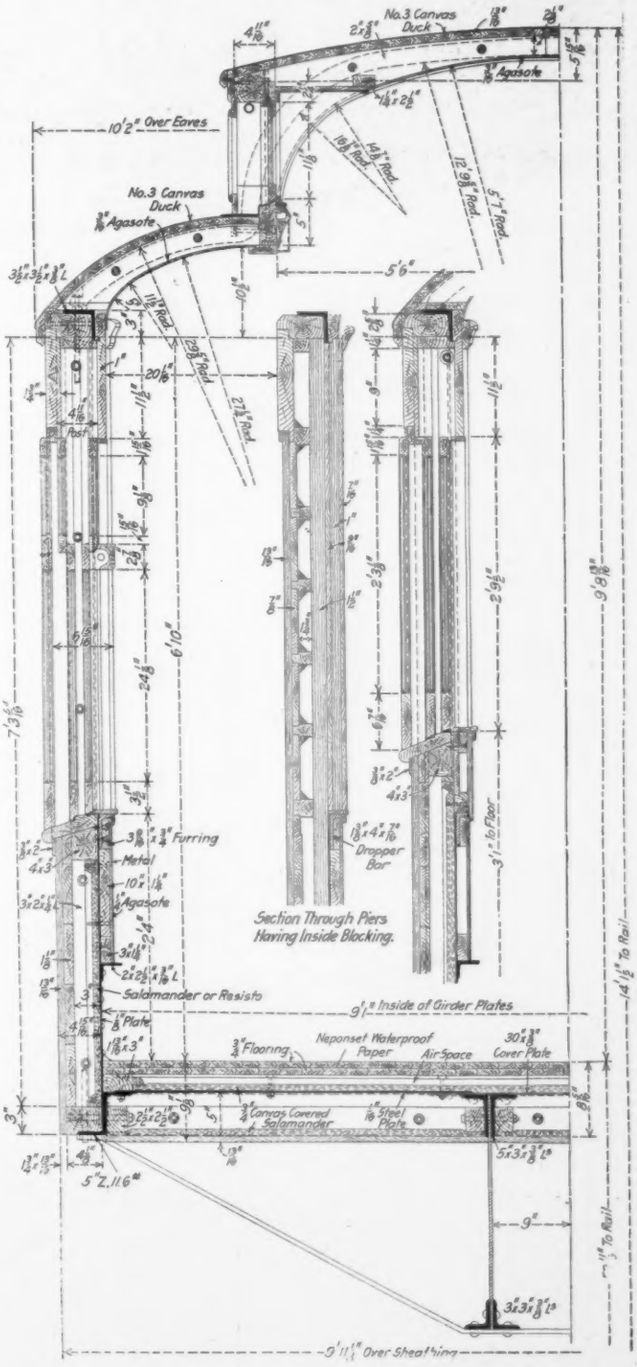


Steel Frame Suburban Car with Wood Finish Recently Placed in Service on the Grand Trunk



General Arrangement of the Underframe of the Grand Trunk Car

upholstering, etc., in a passenger car is more inflammable than a wood inside finish, and that the paint and varnish in a steel car is inflammable. By the adoption of a composite construction the car is claimed to be warmer in winter and cooler in the summer, and in addition, these cars can be repaired in any of the company's shops at the same cost as a wood car, thus saving the expense of buying special machinery and keeping in

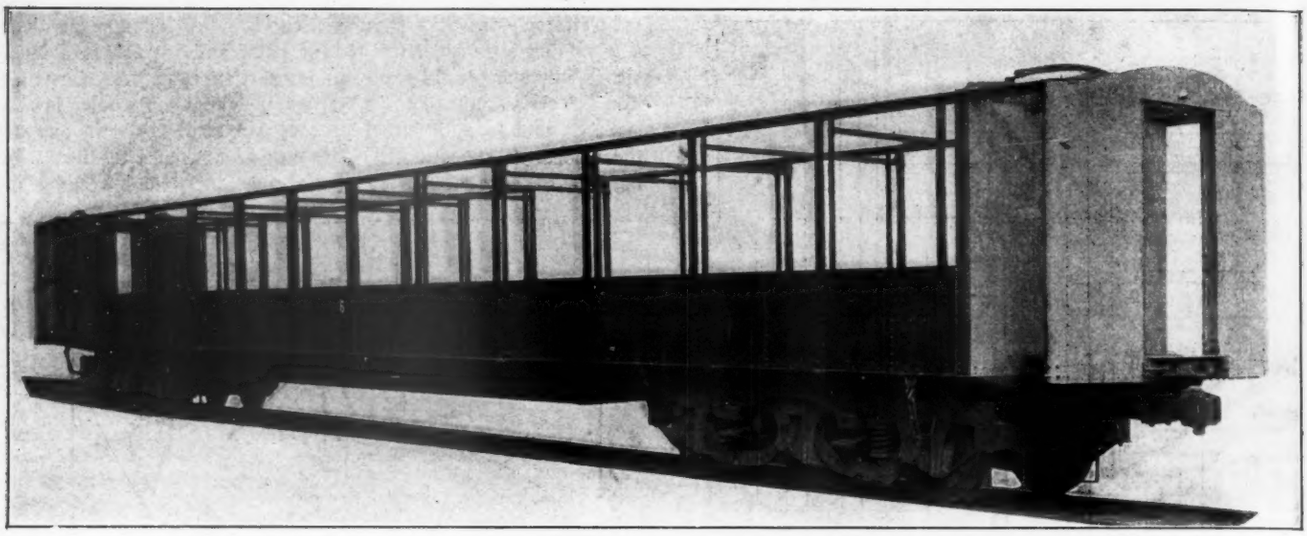


Cross Sections of the Grand Trunk Car

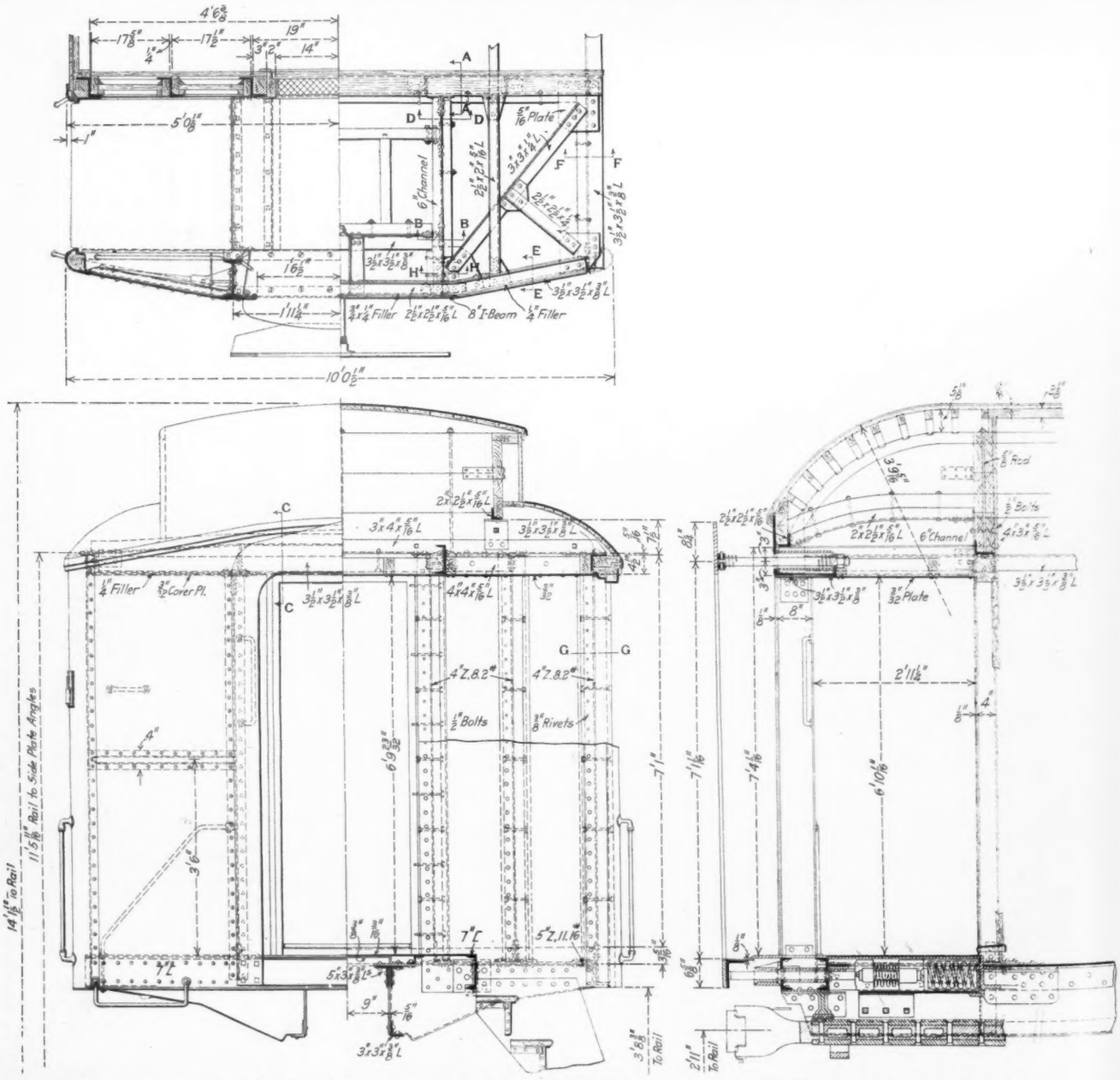
stock special material for repairs, which would be necessary with steel interior and exterior finish.

UNDERFRAME

The underframe is constructed with the center sills as the principal members. They are of the built up fishbelly type, continuous from buffer beam to buffer beam and consist of a 30 in. by 3/8 in. top cover plate, 5 in. by 3 in. by 3/8 in. top angles, 5/16

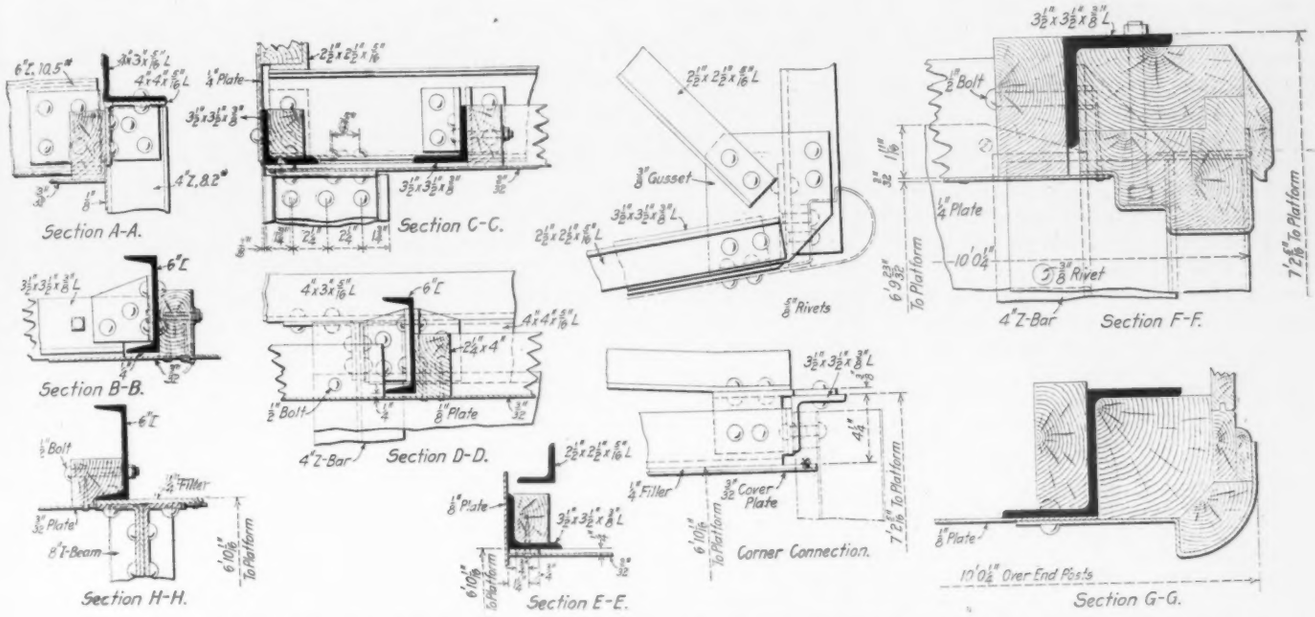


Grand Trunk Suburban Car During Construction, Showing the Arrangement of the Steel Members



End Arrangement of the Grand Trunk Suburban Cars; the Detail Sectional Views Are Given in a Separate Drawing.

in. web plate and 3 in. by 3 in. by ⅜ in. bottom angles. The depth of the center sill at the center of the car is 26 in., and at the bolster 16 in. The body bolster is built up of eight ⅜ in. in. pressed steel diaphragms placed back to back, with 10 in. by ⅜ in. top cover plate and 7 in. by ⅜ in. bottom cover plate, both extending the full width of the car.



Details of the End Framing; the Section Letters refer to the Drawing of the End Arrangement

pressings as side members, one cast steel center member of heavy construction designed to take the locking device, a top cover plate 5 ft. 6 in. by 5/16 in. extending the full width of the

Interior of the Grand Trunk Suburban Car

car and two 7 in. by ⅜ in. reinforcing plates extending from side sill to side sill. There are two crossbearers placed 14 ft. 3 in. on either side of the center of the car and built up of ⅜

BODY AND END CONSTRUCTION

The side girder consists of a 1⅜ in. by 4 in. by 7/16 in. dropper bar, ⅛ in. by 35 in. web plate, 2 in. by 2½ in. by 3/16 in. intermediate angle and 5 in. by 11.6 lb. Z-bar side sill. The side posts are 3 in. by 2 in. by ¼ in. angles, and the side plate is a

An End View of the Steel Work

3½ in. by 3½ in. by ⅜ in. angle. The steel construction of the body is reinforced with wood posts and horizontal and vertical wood blocking. The interior and exterior finish is of wood. Wrought iron carlines, 2 in. by ⅝ in., are riveted to the side plate, completing the steel superstructure, and here again

the wood reinforcing is employed. Canvas duck is used for the final roof covering and the headlining is 3/16 in. Agasote. Agasote is also used below the belt rail. No special insulation was necessary in this construction except below the belt rail, where ¾ in. Salamander is applied outside the ⅛ in. steel plate. Special care was taken, however, for insulation under the floor, two air spaces, two layers of ¾ in. Salamander and one layer of Neponset paper between the upper and lower course of the floor being used.

The end posts are 4 in., 8.2 lb. Z-bars with wood reinforcing, and the end plate is a 4 in. by 3 in. by 5/16 in. angle. The vestibule posts are 8 in., 18 lb. I-beams connected at the bottom direct to the platform end sill, which is built up of 7 in. channels, while at the top these I-beams are connected to the body of the car by 6 in. channels running parallel with the center line of the car and by 3 in. by 3 in. by ¼ in. angle diagonal braces from the ends of the I-beams to the corners of the car body; these braces are in turn braced to the vestibule corners by 2½ in. by 2½ in. by ¼ in. angles. The vestibule end plate is a 3½ in. by 3½ in. by ⅜ in. angle and 2 in. by 2½ in. by 5/16 in. angles brace this plate to the end of the car body between the I-beam and the outside of the car. The vestibule is sheathed with ⅛ in. steel plate.

The interior finish is mahogany and rattan seats are used, the seating capacity of the car being 96. The Stone Company's axle system of electric lighting is used, the generators being arranged to cut in at about six miles an hour, and the cars are heated by the Chicago Car Heating Company's vapor system of steam heat. They were built by the Canadian Car & Foundry Company, Montreal, Quebec.

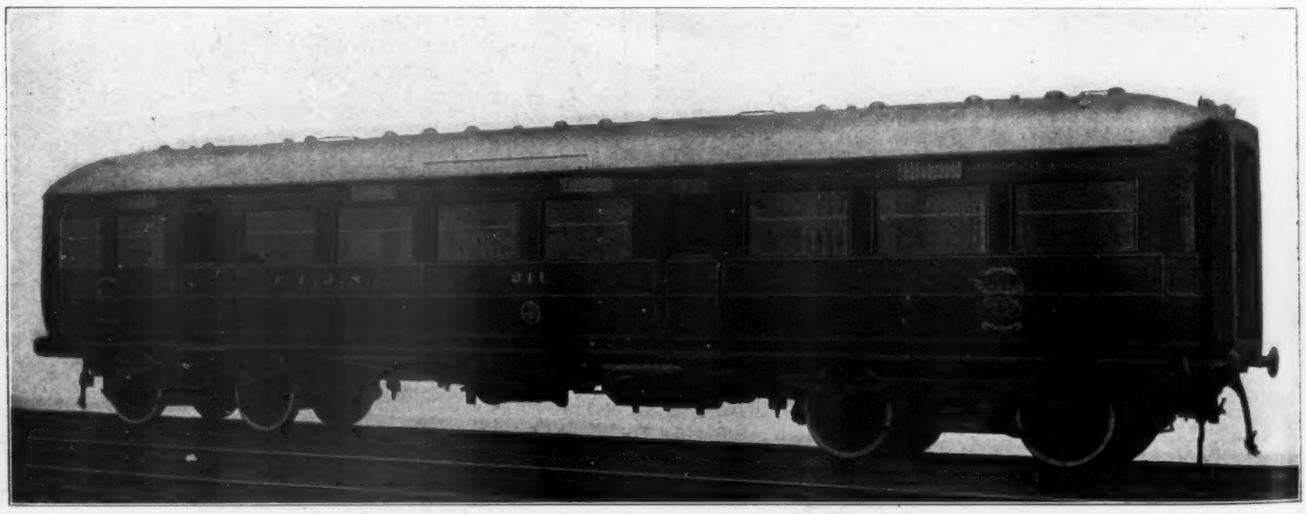
BRITISH ALL-STEEL KITCHEN CARS

The first all-steel passenger train cars to be used in Great Britain were recently placed in service on the express trains of the East Coast Joint Stock running between London, Newcastle, Edinburgh and Aberdeen. There are three of these cars, which were built at the York works of the North Eastern Railway, under the direction of Vincent L. Raven, chief mechanical engineer of that road. They are self-contained kitchen cars, and are devoted entirely to the supply of food, wines, etc., thus acting as tenders to the first and third-class dining cars, one car per train being arranged between these latter cars with a direct service to each simultaneously.

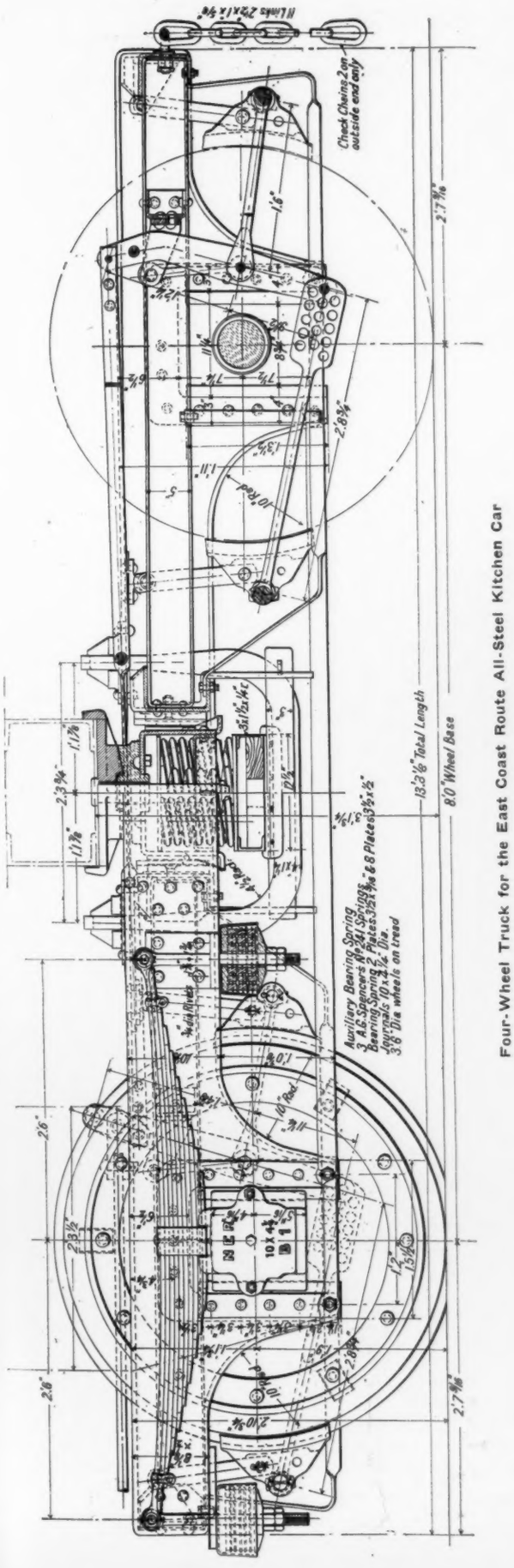
Owing to the difficulty of procuring sufficient current for an efficient electrical cooking installation, gas is used, and it was decided, with a view to reducing the liability of fire to a minimum, to build these cars of steel. All the other vehicles in these trains are lighted by electricity.

The underframe is built entirely of British standard steel sections, and is of the trussed type. The side sills or solebars are in one length, the section employed being 9 in. by 3½ in. by ½-in. bulb angle, trussed with a 1½ in. diameter rod carried 14 in. below the side sill. This member also carries a pressed plate section which supports the body posts, and also forms the lower attachment for the body panels, to which they are riveted. The center sills, or main longitudinals, are in one length from bolster to bolster, and the section is 9 in. by 3 in. by ⅜-in. channel. The end sills, or headstocks, have been made specially deep, in order to bring the body lines uniform with standard East Coast Joint Stock wooden cars, and consist of 15 in. by 4 in. 42-lb. channels. The body bolsters are built up of 10 in. by 3½ in. by ½-in. channels attached to the center sills by heavy knees and angle gussets. The end diagonal braces are 8 in. by 3½ in. by ½ in. angles, while the end longitudinal sills are also angles, 10 in. by 3½ in. by ½ in. section. For the truss rod needle beams, two angles, each 6 in. by 3½ in. by ½ in., are arranged back to back, the queen posts being sandwiched into them at 6 ft. 3 in. centers. The underframe members are all well connected by gusset plates, bent plate and angle knees, the rivets in the main connections being ¾ in. in diameter. To carry the floor plating, in addition to the underframe members, 10 T-bars, 3 in. by 2½ in. by ¼ in., are arranged at 4 ft. centers, and the floor plating is riveted to these and to the main members of the underframe.

The body framing is constructed throughout of British standard rolled angles, channels and T sections, having a breaking strength of 28 to 32 tons per sq. in., with an elongation of not less than 20 per cent. The main posts and the door posts are 3 in. by 2½ in. by ¼ in. angles, bent to the required contour, and secured to the side plates by turning over the flange and to the side sills by 6 in. by 6 in. knees. All intermediate posts and local stiffeners are 1½ in. by 1½ in. by 3/16 in. angles. The side plates are 3 in. by 3 in. by ⅜ in. angles, carried continuously to the end sweep angles or end plates, to which they are connected by means of gusset plates. The top light rail angles, which are above the windows, are 1½ in. by 1½ in. by 3/16 in., riveted to the posts, while the bottom light, or belt rails, are 2½ in. by 3 in. by ¼ in. angles arranged to butt and rivet to the posts, which are stiffened by bent plate knees between each two posts. The end framing has been arranged to provide ample resistance to impact. The corner posts and end posts are all 3 in. by 3 in. by ⅜ in. angles, substantially secured to the underframe by forged knees; the corner posts being secured to the side plates by gusset plates ⅜ in. thick. The top end arches, and the top and bottom framing rails, are



All-Steel Kitchen Car Used on the East Coast Route in England


Check Chains 2 on outside end only
13'3½" Total Length
8'0" Wheel Base
Auxiliary Bearing Spring
3 A.G. Spencer's No. 41 Springs
Bearing Spring 2 Plates 3'2½" & 8 Plates 3½"x½"
Journals 10"x12" Dia.
38" Dia wheels on tread

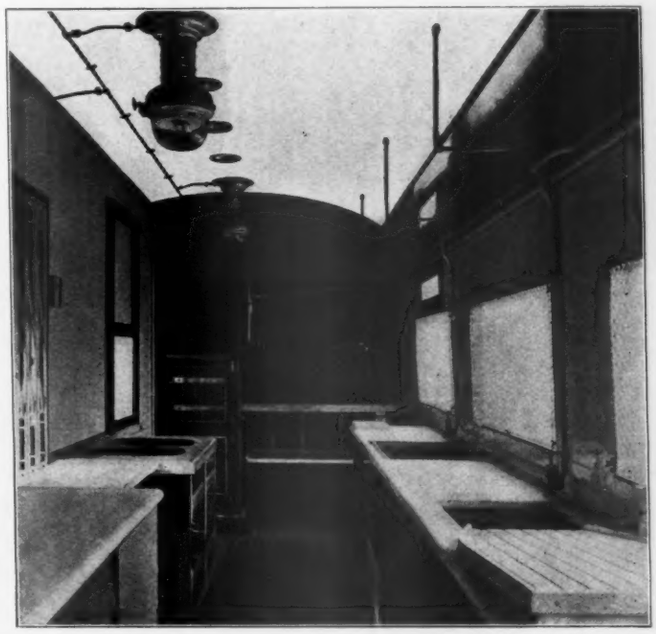
Four-Wheel Truck for the East Coast Route All-Steel Kitchen Car

3 in. by 2½ in. by ¼ in. angles. The ends are adequately stiffened and braced to afford the Pullman vestibule gear the maximum of support.

The whole of the body outside paneling is of No. 16 gage charcoal finish, cold rolled, hydraulically flattened steel plate, arranged in various sizes to suit the framing. The general riveting is 5/16 in. diameter, all outside heads being countersunk in either panel or moulding. The mouldings are of rolled steel throughout and of various sections.

It was found that a thoroughly satisfactory arrangement was produced for holding the windows and inside paneling by filling in the side plates, belt rails and main posts with packing, which is screwed to the steel members. The main doors are lined outside and inside with steel plate of the same gage and manufacture as on the body.

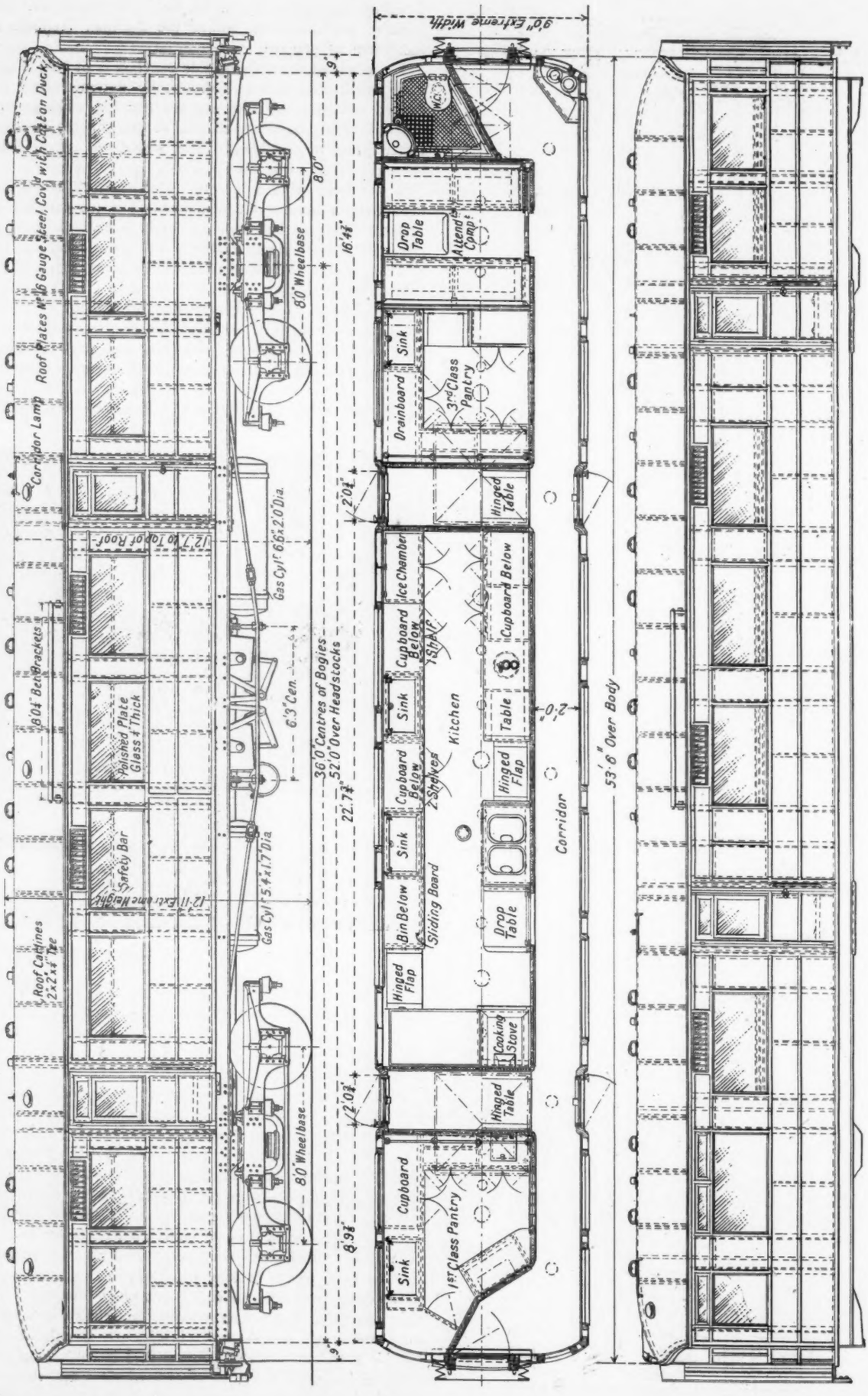
The elliptical roof is constructed throughout of No. 16 gage steel plate curved to a template, and riveted to a series of 2-in. by 2 in. by ¼ in. T-bars, which are connected by gussets and rivets to the angle steel side plates. All rivets are 5/16 in. diameter, with countersunk heads on the outside. A cotton duck roofing canvas is laid over the steel and secured by No. 20 screws



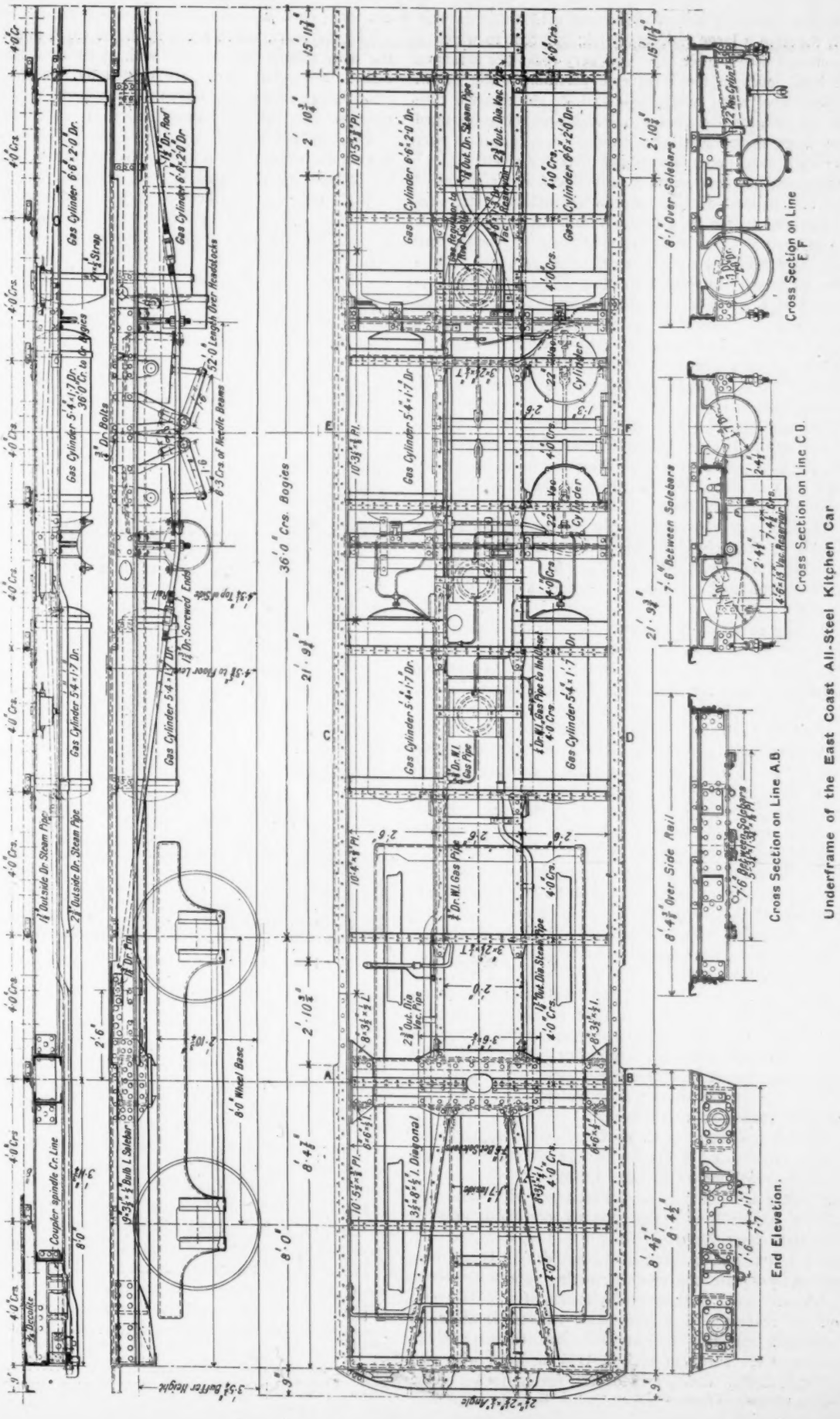
An Interior View of the Steel Kitchen Car

to the side plates and end sweeps by a 2½ in. by 2 in. cornice. The roof ends are swept down 10 13/16 in., in a moderate curve. There are 13 torpedo air-extractors or ventilators arranged on the roof, those in the kitchen and pantries having large bell-mouthed openings, and no valves.

The floor consists of 5 lb. per sq. ft. steel plating laid from end to end, and is riveted to the underframe. It is covered with a plastic cement composition known as Decolite, ¾ in. thick, and waterproof, hygienic and impervious to insects. In the corridor, kitchen, pantries and passages, all square corners are avoided by sweeping the cement into a continuous curve. The corridor interior is fitted on the body side, from the sill to the roof casing, with No. 20 gage steel panel plate, secured to the steel framing packing by rolled steel mouldings. The corridor screen is also covered from top to bottom with the same material, so that the passageway from end to end is perfectly fireproof. The first-class pantry, located adjacent to the first-class dining car, is 9 ft. long, and 6 ft. 3⅞ in. wide inside. It is entered by a collapsible gate, the doorway being 2 ft. 3 in. wide, and every convenience is provided for the storage of glass and chinaware, etc. At the end is a large drainboard for drying off the washed dishes,



Side Elevations and Floor Plan of the East Coast Route All-Steel Kitchen Car



Underframe of the East Coast All-Steel Kitchen Car

with a storage cupboard below. Hot and cold water is supplied at all times to a large teak-lined sink, adjacent to which is another cupboard with a table top. Crockery racks are arranged above the head level on the transverse partition, while below, there are the plate racks, refrigerator and ice closet, wine cupboard, etc., an additional cupboard or sideboard being arranged for with a large complement of drawers. An improved pure water filter with hand pump is arranged over the sideboard.

An incandescent gas lamp of 50 c. p. is placed at the center of the pantry, and flanked by two torpedo ventilators. The ventilation is further assisted by a louvre ventilator, which consists of a series of vertical vanes so arranged that air may be induced or extracted at the will of the operator. A large water tank is placed adjacent to the pantry in the ceiling. The two transverse passages are 2 ft. 6 in. wide, and are necessary for ingress and egress, in addition to which all stores taken on the car come through these doors, and empties may be discharged and new supplies taken on simultaneously. A drop table is provided in both passages. These passage walls are lined throughout with steel plate and steel mouldings.

The kitchen is 22 ft. long by 6 ft. 7⅜ in. wide, inside dimensions. At one end is located the range, occupying the full available width, the partition, roof and corridor screen around it being covered with asbestos and No. 16 W.G. steel plate. The range is raised clear of the floor. At the body side are installed two sinks with hot and cold water supply and a hinged flat table, while the table on the right-hand side serves the chef as a carving table, below which is fitted the cold storage, and the cupboard, which is ventilated, is used for the storage of fresh meat, fish, fruit, etc.

All the serving of meals is done on the corridor side of the kitchen, and the partition at this side is provided with an upward sliding door 2 ft. 2 in. wide, while a drop table is arranged below the hatchway as a serving table. The hot plate and closet are fitted with twelve burners.

The main entrance to the kitchen is off the corridor through a collapsible gate, with an opening 2 ft. 3 in. wide, a folding table filling up the gateway when the gate is closed. To provide for hot water at any time a patent hot-water geyser, gas heated, is installed, the boiler and gas rings being located below the table. The water supply to the boiler is taken from the overhead tanks, and is automatic. Two additional cupboards, the top of which serves as a sideboard if required, complete the kitchen. The ventilation, and the endeavor to avoid the sweating so common to kitchen cars, has been carefully planned, louvre ventilators being arranged over two out of the three windows on the body side, while six torpedo ventilators, with large brass bell-mouths, take out the impure air. The three side windows have double glass, and are protected from damage on the inside by galvanized wire frames. The floor is covered with steel mats, which can be taken up and thoroughly cleaned, in addition to which is arranged a large sump for the removal of all waste. Galvanized refuse bins of large capacity are located below the sinks. The entire kitchen sides and partitions are covered with white enameled iron plates.

Three pedestal gas lamps, each of 50 c. p. are applied, and arrangements are provided in the kitchen for cutting off the gas supply from the receivers on the underframe.

Adjacent to the kitchen is a second passage, with outwardly opening doors, identical with that already described, next to which is the third-class pantry. This is 6 ft. 5 in. long and 6 ft. 3⅞ in. inside width, and is fitted with sink, drying board, bins for mineral waters, plate and crockery racks, pure water filter, hot and cold water, etc. Entrance is by means of a folding gate opening off the corridor. Over the single window is arranged a louvre ventilator, and two roof air extractors are also applied.

The attendant's compartment is 5 ft. 11½ in. long, with two transverse seats, below which are lockers for uniforms. One incandescent gas lamp of 50 c. p. and pilot light is employed, flanked by two torpedo ventilators. A large lavatory adjoins the attendant's compartment, and is set apart for the use of the staff.

The corridors, which are 2 ft. in the clear, and 1 ft. 9½ in. at the door pillars, are covered with sheet steel throughout, varnished teak color. They are lighted by five lamps, fitted with pilot lights; each is of 50 c. p., and ventilated by four louvre ventilators. At the third-class end is a soiled linen cupboard.

The vestibule connections are of the Pullman type, and have canvas and rubber diaphragms. Two wind screens of the spring roller type are also fitted to each vestibule.

The supply of gas for the kitchen, and also for lighting, is carried in five storage cylinders, which have automatic valves to cut off the cylinders in the event of the pipes being broken through accident. The cylinders, and also the regulators, of which there are three, are housed as high in the frame as possible. The gas supply to the stove, hot-plate and lamps is controlled within the kitchen. The brakework is of the vacuum type with two 22-in. vacuum cylinders, and two reservoirs each 4 ft. 6 in. long by 1 ft. 3 in. in diameter. The leverage is so arranged as to produce 76 per cent of the tare weight brake shoe pressure.

East Coast Joint Stock cars use the Buckeye center coupling in conjunction with the Pullman vestibule, and this is fitted to

Another Interior View of the Steel Kitchen Car

these particular cars. The coupler head is of the latest pattern with vertical locks operated from the car side, and pulls directly on to a pair of steel springs arranged in parallel, which bear against steel castings sliding in cheek castings which are attached to the 10 in. by 3½ in. angle longitudinal sills. If required, the coupler head may be hinged, and an ordinary screw coupling attached to a hook forged on the coupler shank for this purpose. The side buffers are of the telescopic pattern, and are not in use under ordinary circumstances, only being extended when running with vehicles with ordinary screw couplings.

The cars are mounted on two four-wheel trucks of 8 ft. wheelbase, placed 36 ft. between centers. They are of the Fox pressed steel pattern, and have side frames ½ in. thick.

The weight of each car is 36 tons (of 2,240 lb.), which includes about 200 gallons of water in the roof tanks.

The principal dimensions are as follows:

Length over body vestibules	55 ft.
Length over body	53 ft. 6 in.
Length over end sills	52 ft.
Distance between truck centers	36 ft.
Truck wheelbase	8 ft.
Width outside body over mouldings	9 ft.
Width of corridor	2 ft.
Width over footboards	8 ft. 10 in.

SHOP PRACTICE

SPECIAL CHUCKS FOR AIR PUMP REPAIRS

BY W. W. ELFE
Machine Foreman, Central of Georgia, Macon, Ga.

A simple chuck for bushing valve chamber heads on 9½-in. air pumps is shown in Fig. 1. The chuck is made from a piece of ¾-in. by 7-in. wrought iron, the feet and inside face being machined so that they will be parallel. It is secured to the face plate of the lathe by means of bolts and proper alinement

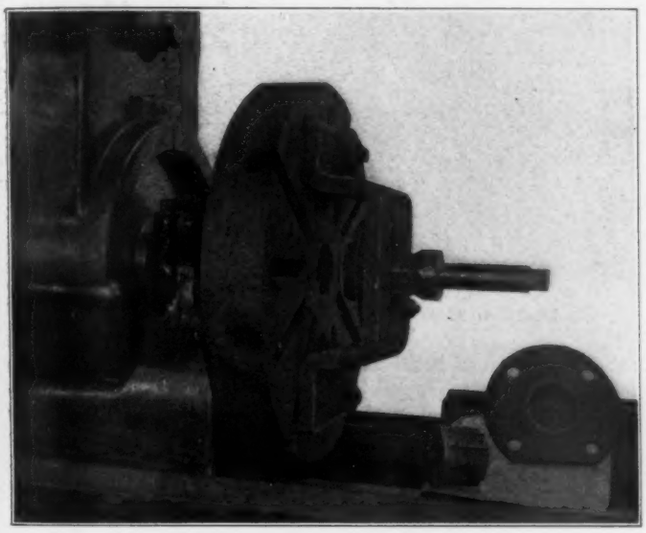


Fig. 1—Finishing Air Pump Valve Chamber Head for Bushing

facilitated by the use of dowel pins. A hole is bored through the center just large enough to fit the projection on the inside face of the head so that accurate chucking is accomplished without loss of time. Two shell reamers of high speed steel, both

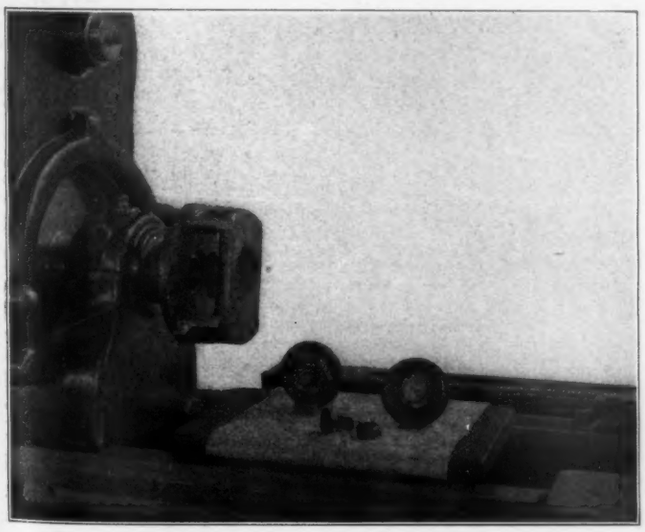


Fig. 2—Chuck for Repairing Worn Air Pump Check Valve Caps

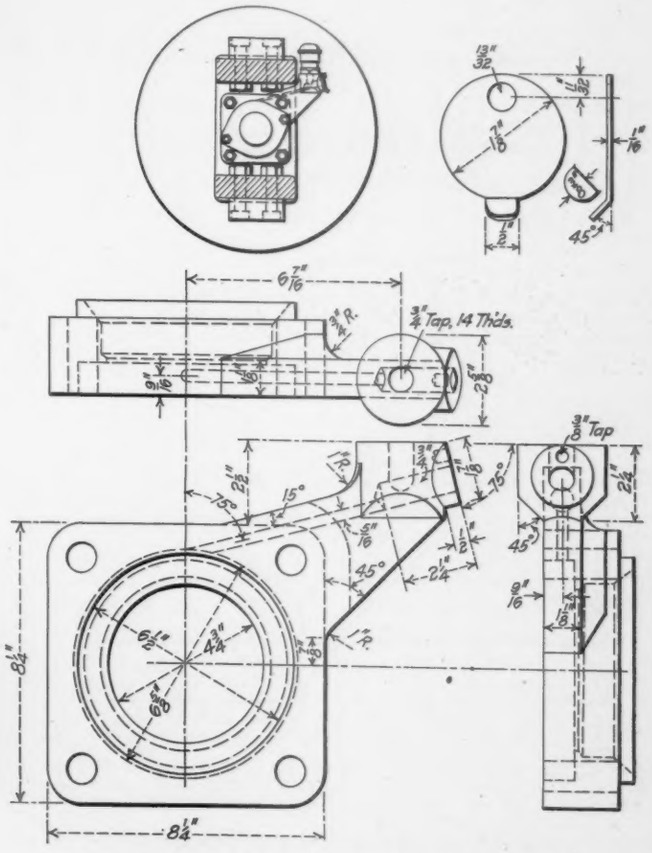
fitting the same machine steel arbor, are used with this chuck. The larger one sizes the head for the bushing, which is applied with a press fit. After the bushing is applied the smaller reamer is used to finish it on the inside. The bushings are 1 11/16 in. in length and 2 7/16 in. outside diameter, the finished inside diameter being 2⅛ in. When worn more than 1/32 in. they are removed and new bushings applied.

Fig. 2 shows a chuck used in reclaiming worn check valve caps from the air cylinders of 9½-in. air pumps. The chuck is bored to fit over a small face plate to which it is secured by means of two ½-in. cap screws. A hole is bored through the center and threaded so that the cap may be screwed in from either the front or back. The illustration shows the check screwed in from the back to have the valve stop faced off and to be drilled through the center for the dowel. The dowels are made on a turret lathe from 1 in. round bars, the shank being finished to ½ in. in diameter and threaded to receive a nut. After the cap has been bored it is removed from the chuck and replaced from the front, in which position the head is countersunk to receive a ½ in. nut. The body of the dowel is finished to a driving fit and after being driven into position is secured by means of the nut. The appearance of the repaired cap is clearly shown in the illustration.

PISTON ROD GLAND AND OILER

BY JAMES STEVENSON
Gang Foreman, Pennsylvania Railroad, Olean, N. Y.

The combined piston rod gland and oil cup shown in detail in the drawing is designed to replace the usual method of oiling



Piston Gland with Direct Attachment for Oil Cup

the piston rod packing through a pipe from an oil cup on the top guide. It is simple in design and includes a sight feed as

well as a means of access to the oil passage for cleaning without removing the oil cup.

An arm extending out to clear the side of the guide bar is cast on the upper outside corner of the gland. A 5/16 in. diagonal passage is drilled through the arm to the inside of the gland and the outer end of the passage is counterbored to a diameter of ¾ in. Into this enlarged passage is drilled and tapped a ¾ in. vertical opening to receive the oil cup, and the end of the diagonal passage is closed with a swinging cover secured by means of a ⅜ in. machine screw. By opening this cover it may be readily ascertained whether or not the oil cup is feeding properly, and in case new packing has been applied more oil may be added without disturbing the adjustment of the oil cup. By inserting a wire at this point the oil passage may be readily cleaned without removing the oil cup. This device was developed by the writer, and a patent has been applied for.

MOTOR DRIVE FOR A BRADLEY HELVE HAMMER

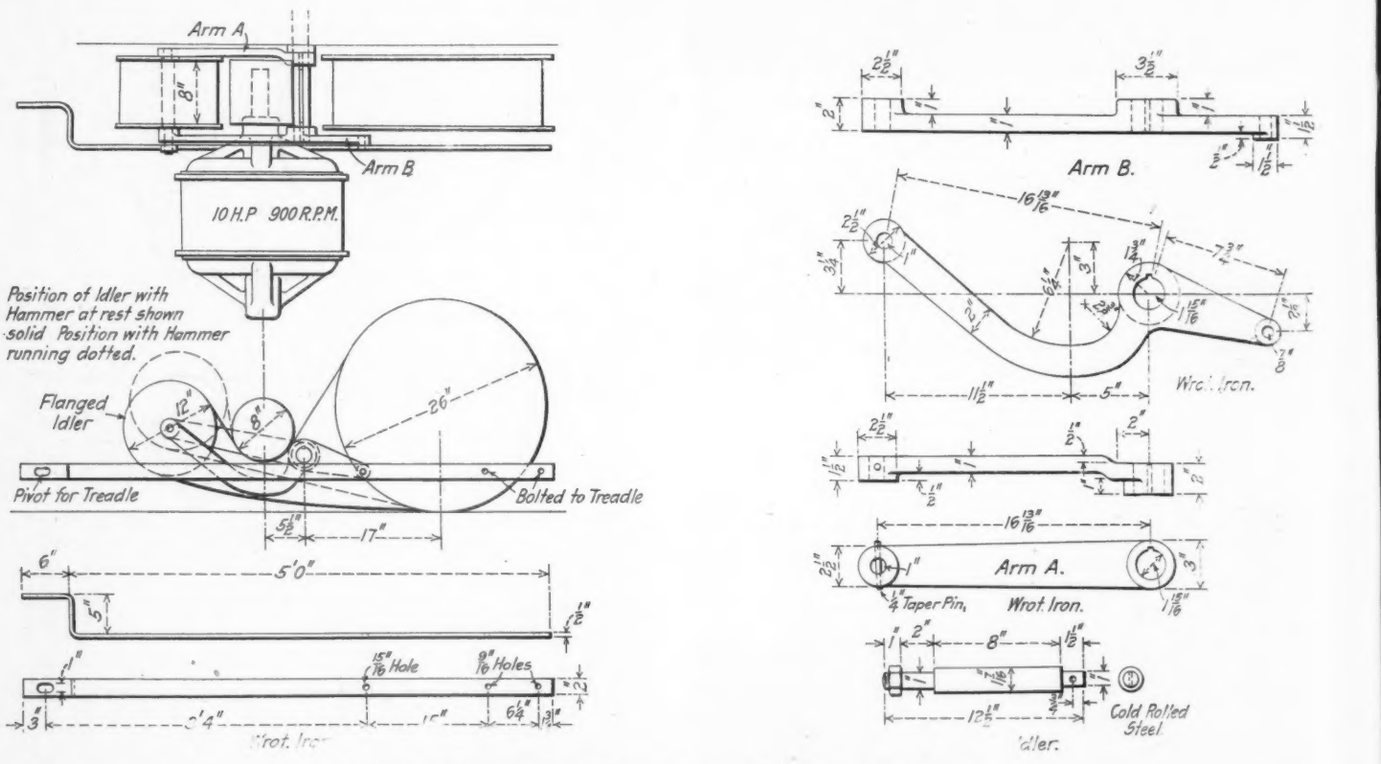
BY W. E. JOHNSTON
Chief Draftsman, Western Pacific, Sacramento, Cal.

When making the tool layout for the blacksmith shop of the Western Pacific, at Sacramento, a 200-lb. Bradley helve-hammer was desired in a location near the center of the shop where the usual overhead drive would have been difficult to install on account of the height of the roof trusses. A framework resting on the floor for the support of the countershaft would have been unsightly, besides obstructing the space around the hammer.

To meet these conditions, the special drive shown in detail by the drawing was installed and has proved entirely satisfactory. As shown in the photograph an induction motor is placed at the side of the hammer where it offers but little obstruction to the free use of the floor space around the machine. The motor runs continuously during the working hours. The hammer is operated by the treadle in the usual way. An idler pulley is secured between the ends of a double lever operated by the treadle. Pressing down the latter raises the idler, tightening the belt and increasing its arc of contact on the motor pulley. The pulley is of cast iron and soon acquires a high polish, so that it runs against the slack belt practically without friction, but "takes hold" and starts the hammer promptly as soon as the treadle is depressed.

Location of Driving Motor for Helve Hammer

This drive has been in continuous service for over a year and a half with no attention other than the occasional tightening of the belt as would be required with any belt drive.



Method of Operation and Details of Motor Drive for Helve Hammer

EFFECTS OF IMPURE WATER ON TURBINE BLADES.—Impure water, even though treated, is sometimes the cause of a fine coating of lime forming on turbine blades.—*The Engineer.*

AN INSPIRING ADDRESS TO APPRENTICES*

"It Takes Great Courage to Perform a Perfect Task on a Thing That May Never Be Seen"

BY GEORGE M. BASFORD

Every man living, with real blood in his veins, desires to do something big, something noteworthy, something brave, something courageous. To have one's name associated in the public mind with some great heroic act, or some important work, gives a thrill of pleasure. To be the one to step forward from the crowd and show the way out of a difficult emergency, to be a leader, to wield power, to hold a place of prominence is the ambition of every real man. It is a natural and proper ambition. Thousands, many thousands of young men in the terrible fights of the European war are ready and eager to show their courage. They are impatiently waiting for calls for volunteers for difficult and dangerous service. They wish to be useful, they desire to make names for themselves and they know that the whole world is looking on, equally eager to admire and reward heroism with public approval. The dramatic features of a submarine torpedo attack, of the rescue of human life at a fire or in a runaway on a crowded street have an important influence on the men who make the rescues. It necessarily must be far easier to enter a burning building to save lives than to stagger against a winter storm on a desolate beach and struggle against a frozen gale to give warning of a shipwreck.

Who are the greatest heroes of the fight to the horrible finish of two battleships? They are the firemen, down in the bowels of the ship where the temperature is 150 deg., hot enough to drive men to madness. They tend their fires when the armor is pierced, when the electric plant is out of business, so long as the main engines are working. They then work in the dark, except for the light of their furnaces. They do not know the inspiration that comes from seeing the effect of their own work. They usually go down with the ship, but if victorious, victory is due to them as much as to those who wear uniforms and who inspire the poets.

It is difficult to be courageous and to do an arduous duty when no one is there to see, to praise or to know. If life could be concentrated so that we could nerve ourselves to individual, powerful efforts it would be easier to succeed, easier to win a high place and to keep it. Life, however, is not like that and success cannot come in that way.

You see the highest officers of this railroad passing through the shop where you are working. You cannot help admiring the men. You often think how fine it would be if you could drop your tools, wash up, dress up and be like them. They appeal to you because they are prominent, they are successful and they seem to you to be very powerful. They are big men, they are doing big things in a big way and you are ambitious to be like them. They are heroes in your eyes, as they are in mine. They are human, however.

How do these officers get to these high positions? Do they accomplish it by a few spectacular performances with the world watching and waiting to give its approval and its reward? They do not. These men are trusted with their great responsibilities, they have gained their high positions, because they have done something far different from that. These officers have worked like the surfman patrolling the beach. They have worked faithfully, in comparative obscurity, for many years. They have done the most courageous thing any man is called upon to do. Greatest courage is required, not for spectacular things, but for plain, simple, everyday work, in quiet obscurity. It takes great courage to perform a perfect task on a thing that may never be seen and where imperfect workmanship cannot be traced and laid at your door. It requires more courage to do a good and thorough job for someone else, a perfect job and do it every day, whether you think anybody will see it or not, than to climb to a burning roof to rescue a human life. Because these men are heroes of this everyday kind they have been elevated to their fine positions.

You look at them as they pass through the shop and you wish to be like them. If you do as they have done you may perhaps be like them. You see the officials of the road as grown men in so-called middle life. Perhaps it does not occur to you that they ever were boys. Picture them as boys and young men of your own age. Life looked to them as it now looks to you. They, however, were different in some way from their comrades. At your ages they were probably but very little different and the difference was perhaps in attitude, in loyalty, in the courage that we have been considering. They certainly were good workmen and they were good subordinates, or they would never have been preferred and promoted. They were earnest. They were loyal. They did not do and, therefore, did not conceal bad work. They were doing something every minute. They selected friends in the shop that were worth while. They chose to admire good, strong, efficient men and they did not listen to the noisy fellow who told them that the bosses would think no more of them for extra effort or steadfast loyalty. They were, however, human.

Their successors are in this gathering tonight—who are they? You may all have ambition which will bring you no disappointment. You may not all be superintendents of motive power, but you may all be something else that is equally honorable and equally important. You may all be competent, honest, efficient workmen, doing good work every day. This will bring you satisfaction and happiness, for you will feel that these officers depend upon you and that they cannot hold their positions without you.

It does not matter how high you climb, but it does matter how far you climb. A friend recently told the graduating class of Harvard University that it means more to climb Mount San Bernardino than to climb Pike's Peak. The former begins at a point 300 ft. below the level of the sea and rises 11,000 ft. The latter begins at a point 7,000 ft. above the level of the sea and rises 14,000 ft. above that level, a real climb of 11,000 ft. in one case and 7,000 ft. in the other. It's where you start and where you finish that counts. These good friends and this good railroad are supplying the equipment for your climb. How far will you go? That's up to you.

These officers reached their high positions by climbing. When they started they prepared for the first step. They then prepared for the next one. They were always ready for the next job and they impressed this fact upon all who were around them. They were not to be kept down.

You are preparing for your first step in promotion. Have a care as to the preparation. Make known by your work that you are ready for the next step and patiently wait for it, making the preparation more secure as you wait. Somebody here this evening will be the first to be sought for and promoted. Are you prepared? Is it to be you?

As these officers go through the shop you see them. Do they see you? They certainly do. They are keen observers. They see you and what is more they see your work. Knowl-

*From an address entitled "Heroes," delivered before a meeting of the Chicago & North Western apprentices at Chicago on February 15, 1915.

edge of that also comes to them in their records of cost and of engine failures. Be assured the officers know every good workman. They know every hero in their ranks. They know better than you do what it means to be a good, faithful, efficient workman. They know better than you do that this is the foundation for the only success that is worth while.

When he passes you in the shop can you hold your head high, look the superintendent of motive power squarely in the eye, as a good American workman, feeling that you are absolutely necessary to him to aid him in dealing with his many and varied responsibilities? He may find you fitting up a driving brass, driving a rivet, beading a flue or putting in cotter pins. Let him find the work perfect and done at proper cost of time and material. He will know that that job will not worry him later as the cause of an engine failure.

That little cotter pin may bring in the train. Its absence may cause the wreck that costs the life of your father, your brother, your mother. But if the officer does not see your work, you yourself see it and when you look into the glass you wish to see a man and not a moral coward. Think how that passenger engine you worked on last week depends upon you, upon your heroism to resist the advice of one of your cowardly colleagues, who may say: "Let it go. It's good enough. No one will thank you for more than a passable job." If no one sees it, your reward will come in being able to walk out of the shop at quitting time, holding your head up, knowing that you are a man and that you have done a real man's work.

The Chicago & North Western has made you, has trusted you and honored you with this great opportunity. It holds out to you, as few railroads do, opportunities for preferment and advancement. This organization is led by men who grew up from the ranks, from positions such as you now occupy. The head of this motive power department has spent all his years of service on this road. Today Mr. Quayle stands with the greatest leaders of his calling. So does Mr. Bentley. They give you a better opportunity than they themselves ever had and beckon you on to the greatest advancement of which you are capable. They have established an ideal for you to strive toward. Their superior officers support them and offer you the best opportunities offered to any young men in railroad service today.

The future is up to you. Will you be traitors? Will you be heroes? Choose. Choose to be heroes in the heroism of simple honesty in the work that shows and in that which lies concealed, that you may look back in years that are to come, proud that you have done an important part in making the Chicago & North Western a better railroad than it was when it took you in and gave you this place in a great organization of real men. Are you worthy? Are you worth while? If you are not satisfied with your own answer you have something to do. "To see what is right and not to do it is want of courage."

A railroad as a business organization is like an army fighting its way step by step up a long hill. Many fall as they advance. Somebody is taking their places. Will you take these places or will you loaf and straggle and let the honest, earnest ones pass you? Will you shirk or will you work? You may shirk into a narrow, selfish existence of little value to yourselves and to others. You may work into a condition of useful progress, as these officers have done, but to go as high as they have you must aim high and you must consider, as they do, that nothing is ever finished.

How can I start a lot of lively young men like you to thinking of the future so that you will make the necessary efforts to take the places that you ought to take? Let me give you the story of "Reddy" Johnson as I had it from a friend down East.

"Reddy" was a machine shop apprentice eighteen years old and had nearly finished his time. He looked forward to a foremanship more than to anything else in the world. The concern had a traveling salesman, Van, by name, who sold all the shop could make. He had graduated from the shop and made $3,000 a year. He did about as he liked, was looked up to by everybody and what he said "went" with the old man. "Reddy" thought him a prince and wondered if he would ever reach so high a place. Whenever Van came to town he would come into the shop, talk with the foreman and look after his orders. He came in one day and wandered over to see "Reddy."

"Well, 'Reddy,'" he said, "when are you going to be foreman?" Then he sat down and drew "Reddy" out. "You can be foreman either of this place or some other, just as soon as you can boss men. You've got to start in and practice just as you did on the lathe and planer."

"How can I practice?" asked "Reddy," "I'm only a cub here and everybody bosses me and I've got to do as I'm told."

"Well, 'Reddy' Johnson, you can practice on one and that's Johnson."

"Me?"

"No, not you, but Johnson. Every man has two distinct personalities in the one body. One is energetic, ambitious, likes to do right and get along. That's you, 'Reddy.' The other is careless, shiftless, lazy and fond of a good time. That's Johnson. Now, 'Reddy,' what you've got to do is to learn to boss Johnson, your other self, and you'll find it a big job. When you can boss Johnson successfully and keep him up to the mark all the time and keep him good natured about it—then and not till then you'll have the skill and practice to boss more than one man."

The idea struck "Reddy" and he tried it. In the course of a week he liked the game. As "Reddy" the foreman he bossed Johnson the workman and jacked him up whenever necessary, and, according to "Reddy," Johnson was a bad one. Van went out on the road and "Reddy" went after Johnson. He made him study, checked him up in his work and had a poor opinion of him generally. One night he went to a show and before the curtain rose he heard two people talking in front of him. One had been away and said: "How's 'Reddy' Johnson doing?" "Fine," said the other, "he's assistant foreman at the shops now, in charge of erecting, with from three to ten men under him all the time."

"Reddy" heard no more of the play. "Was I foreman?" thought "Reddy." "How long have I been foreman? When the new wing was put up six months before I was put to work in it with some helpers and my wages raised. Yes, I had been foreman for six months and was so busy bossing Johnson I hadn't noticed it."

This is said to be a true story of the real start of a successful man. Think it over. Try it.

Let me leave this thought with you.

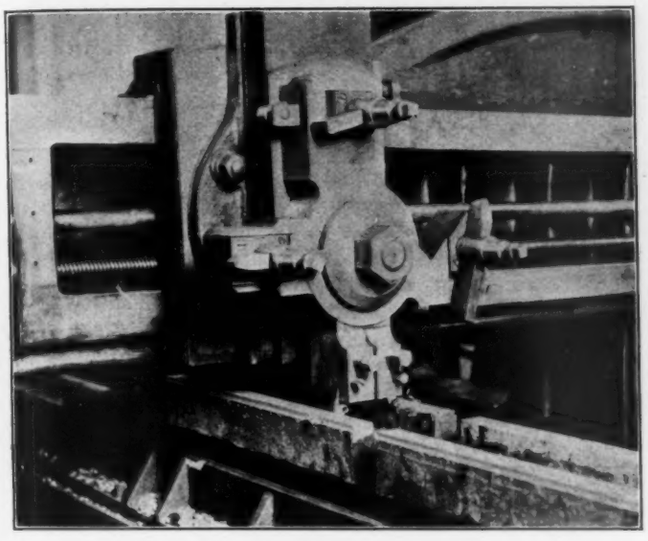
One stone at a time builds the world's greatest structures. One step at a time makes our journey. One day at a time makes our lives. Little improvements in small things faithfully continued make men great.

Poles for Transmission Lines.—The choice between steel and wood poles for transmission lines is mainly a question of first cost plus maintenance charges. In the industrial districts of England there are many reasons why wood poles cannot be run in a straight line, with the result that the spans usually do not exceed 85 yd. in length. For such spans it is cheaper in first cost to employ wood poles which require no after maintenance. Under exceptional conditions, such as in Cornwall, longer spans can be used and steel poles can then undoubtedly be employed with advantage. Steel poles should not be employed in smoke and fume-laden districts without the most careful investigation, because experience with them on tramway and railway systems has shown that their rate of deterioration is rapid, and the cost of maintenance in painting, etc., is high.—*The Engineer.*

TURRET HEAD FOR PLANING GUIDES, SHOES AND WEDGES

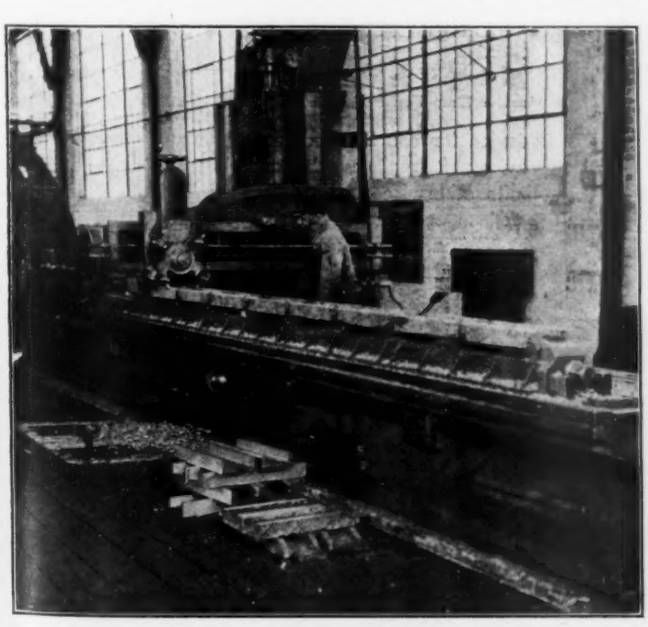
BY B. O. YEARWOOD
Machine Shop Foreman, Virginian Railway, Princeton, W. Va.

The planer turret head shown in the illustration was designed by the writer and applied to a Detrick & Harvey 42 in. by 20 ft. open-side planer for use in finishing guide bars, and both the inside and outside of shoes and wedges at one



Turret Head Set for Finishing the Inside of Shoe Flanges

setting. The saddle on the crossrail is of the standard pattern and the only change required for the application of the turret head was the insertion of a central stud in the vertical slide, about which the turret head revolves. The turret has four arms, three of which are each provided with a single



Finishing the Outside of Driving Box Shoe Flanges with Planer Turret Head

tool post taking tools of ¾ in. by 1½ in. section. The fourth arm is provided with two tool holders in which are secured ¾ in. square tools for finishing the inside of shoe and wedge flanges. Both guide bars and shoes and wedges are clamped in a special jig provided with a single tie rod, thus making it necessary to tighten but one nut in clamping the whole job. Locomotive guide bars are planed from the rough forging, the face and both sides being machined at one setting ready for finishing on the guide bar grinder. Shoes and wedges are completely finished at one setting ready to be placed on the engine and laid off. The illustrations show the construction of the turret head which provides for planing both sides of the work at one time. Both the inside and outside of shoes and wedges are finished in one operation and the single tool mounted in the straight arm is used for finishing the horizontal surfaces. Steel shoes and wedges are being finished in this manner for 9 to 11 cents each.

SUGGESTIONS FOR A PROPERLY KEPT ROUNDHOUSE*

BY W. U. APPLETON,
General Master Mechanic, Canadian Government Railways, Moncton, N. B.

The foreman who is under the impression that it is necessary to maintain a comparatively large staff for the special purpose of keeping the shed clean is under a misapprehension as the proportion of roundhouse expense directly chargeable to such work should be very light. One or two men assigned to general cleaning should be ample at our largest sheds and with the different gangs and individuals doing their part the sheds should always be in a presentable condition. With men assigned to do all the work the tendency is to cause the other classes to become careless and untidy, resulting in a dirty shed at all times. The wood wheeler should carry a broom and after unloading the wood and putting it on the locomotive should gather up all refuse and make proper disposition of it. He can also assist materially by keeping the wood pile in proper shape and using the small broken pieces. The same applies to the fire builder who should keep the floors of the cabs clean and free from coal, etc.

Proper receptacles should be located between the pits for dirty waste and the wipers should be careful to always gather up and put their waste into them while performing their work and when completed. This means very little effort and loss of time compared with the result to be accomplished. Suitable inexpensive receptacles may be easily made from worn out air reservoirs and smoke stacks.

The ashpitmen should keep the premises about the pits and their shanty in a neat condition and a suitable inexpensive rack should be provided for the tools and hose. They should insist on the valves of the water supply being kept in good condition to prevent waste of water which is generally expensive and sufficient of which might easily be wasted to be equivalent to $1 or $2 a day.

The tube cleaners should where possible take care of all soot and cinders removed from the tubes or front end. The boilermaker helper or other employees could assist to a large extent when removing ashes and cinders from a front end by always putting them into the barrow or trolley that would ultimately be used to carry them away instead of throwing them on the floor. This would prevent a duplication of the work and a dirty shed.

Fitters using blocking, etc., should see to it that it is properly piled in the places assigned for it when the work requiring it has been completed and all tools should be kept together and returned to the tool room when not required.

Suitable scrap bins are important; separate bins for the different classes of scrap to the extent necessary to avoid extra handling should be provided and the bin for worn out brake shoes should be so arranged as far as possible to permit inspection of the shoes at all times. A bin for scrap material

*Extracts from an article in the Canadian Government Railway Employees' Magazine, January, 1915.

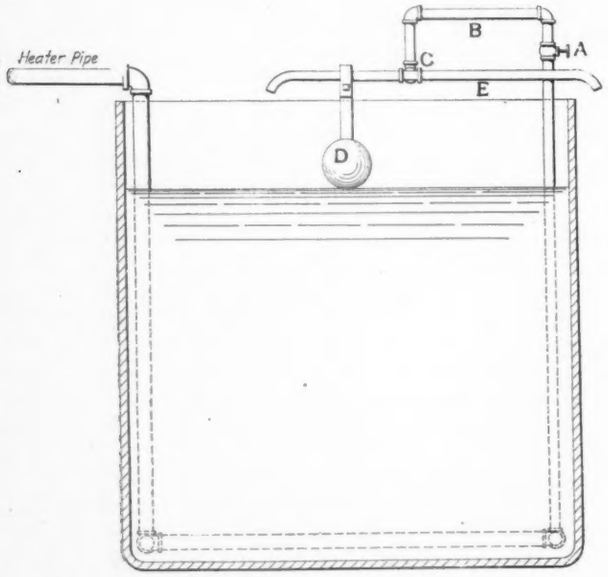
that there is possibility of working over is a good feature and all bins should be periodically inspected by chargehand and foreman to insure against good material being scrapped. All scrap should go to the bins as it accumulates; if a defective arch bar or spring hanger is replaced it is equally important to make prompt and proper disposition of the defective part as it is to replace it, as far as organization is concerned. All scrap brass and copper should be personally inspected by the chargehand who should decide regarding its disposal and a system of getting proper receipts for it should be in effect. Valve bodies are sometimes condemned owing to defective seats when they are fitted with removable seats and it is only necessary to renew the seats. A careful check should be kept on all valves, gages, regulators and air brake materials and requisitions for new stock should never be issued without first ascertaining what has become of the old.

CARE OF LYE TANKS

BY J. A. JESSON

The lye tank is an important feature of shop equipment for the repair of the various parts of the air brake apparatus and other locomotive appliances which has received comparatively little attention. The writer has experimented considerably with tanks of various shapes and with several methods of regulating the solution with results that were very interesting as well as beneficial.

The ideal location for a lye tank is inside the shop, where the temperature of the atmosphere is constant. When located in the open air the conditions are such that it is difficult to maintain a solution of uniform strength. It is impossible to even approximate the amount of raw lye required, especially where the contents of the tank are being continually changed and where the tank cover is not a close fit. From tests made in the open air with a tank 2 ft. wide, 2 ft. deep and 8 ft. long, the solution in which was 18 in. deep, the evaporation at an atmospheric temperature of 80 deg. amounted to 6 gal. per hour, or at a rate which would result in an entire change of volume in 30 hours. At a temperature of 20 deg. the evaporation was 8 gal. per hour, or an entire change in 23 hours. To automatically maintain the depth of the solution at 18 in. under such varying conditions proved to be a difficult matter. The common practice of feeding steam to the solution through a certain size orifice in the steam pipe proved to be wholly unreliable. A sensitively operated float valve gave very good results so long as the valve remained free from leaks, but scale from the steam pipe would lodge upon the valve seat, resulting in an increase of water supply and consequent danger of overflow. Several float arrangements were tried out, but finally the device shown in the drawing was adopted and the results have been most gratifying.



Automatic Regulating Device for Lye Tanks

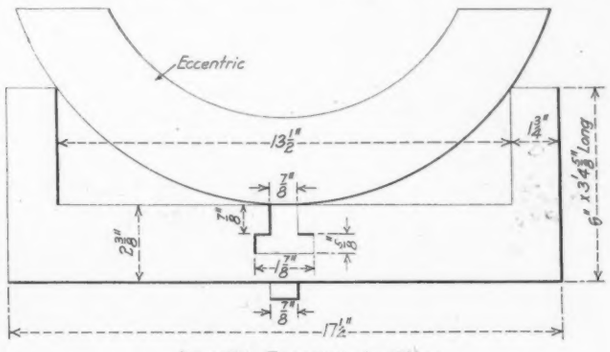
A ¾ in. heating pipe is located around two sides and one end of the tank. To prevent excessive boiling of the solution around the down pipe to the heater it is well lagged with rope asbestos. The outlet pipe from the single heater coil leads to a ¼ in. globe valve *A* which admits the condensation to a ½ in. pipe *B*. A loose connection is made at the tee *C*. A float *D* is connected between the tee and the inner end of the pipe *E*. As the solution evaporates this pipe will be pulled down and the condensation will flow into the tank. As the level of the solution is raised the pipe is also raised until the excess condensation flows out at the other end of the pipe *B*, which delivers outside of the tank. Sufficient heat to bring the solution to a gentle boil and an ounce of raw lye to each 18 gal. of evaporation seems to meet all requirements.

In cleaning air pumps waiting repairs, the pump is placed in the tank in an upright position, supported by iron bars which engage the upper flange of the center piece and rest on the rim of the tank. The usual steam and exhaust connections are made and the air cylinder inlet and discharge connections are provided with pipe fittings, the open ends of which are immersed in the tank. The solution can thus be taken in and forced out of the cylinder back to the tank without any loss and the connections can be readily changed for passing fresh water through the pump without its coming in contact with the contents of the tank. By this arrangement the interior and exterior of the cylinder are thoroughly cleaned in a remarkably short time. A loose partition is placed in the tank to prevent the disturbance of the solution in the other portions.

JIG FOR PLANING ECCENTRICS

BY H. L. LOUCKS
Machine Shop Foreman, Erie Railroad, Dunmore, Pa.

A simple device for chucking eccentrics on a planer is shown in the engraving; it replaces the miscellaneous collection of blocks and bolts otherwise required for this purpose. The device is designed to be attached to the planer bed and is 3 ft. 4⅝ in. long by 17¼ in. in width. The height of the sides is such that when the eccentric is in position it is firmly held from rolling and may be secured by a single clamping bolt in the tee slot in the bottom of the jig. Several pieces may be finished at one time. Other material, such as shoes, wedges, gibs, crossheads, etc., may be planed in the same device, the sides providing a means of pinching and holding the piece in line.



Jig with Eccentric in Place

MACHINE STEEL FOR SMALL TOOLS

BY OWEN D. KINSEY
Toolroom Foreman, Illinois Central, Burnside, Ill.

Soft steel as a material for manufacturing small tools is worthy of consideration, and it is surprising to learn how extensively it can be used as a substitute for the higher-priced materials. Steels used in tools in railroad service may be classified under three heads, namely: High-speed steel; first carbon steel and second carbon steel, the last two being commonly

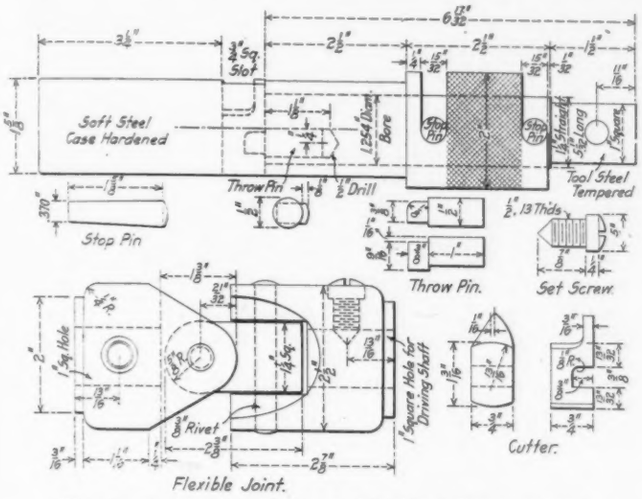


Fig. 1—Flue Cutter Made of Soft Steel Casehardened

known as tool steels. High-speed steel is, as its name implies, a steel that is suitable for cutting metal at high speeds. Its introduction revolutionized metal working and has brought about a marked advance in production. It is the most expensive of the three grades named, its value ranging between $50 and $60 per 100 lb. There is a great difference of opinion as to its

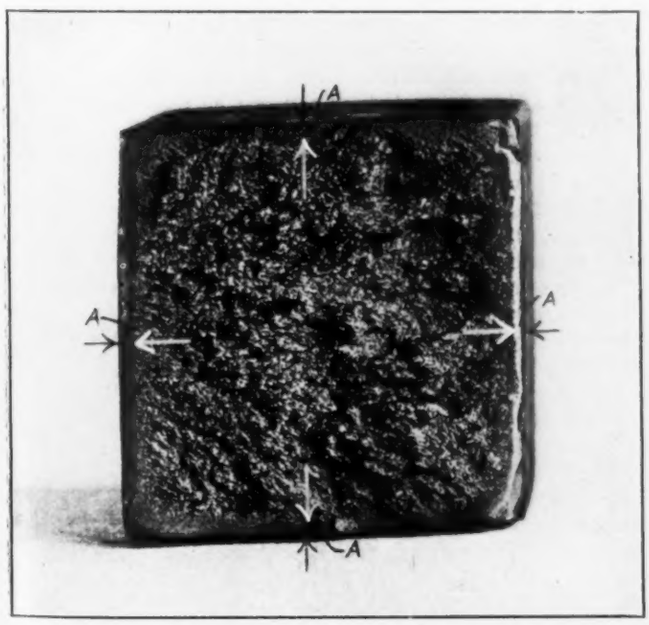
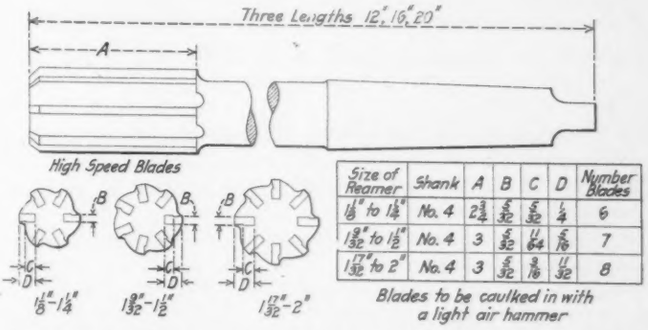


Fig. 2—Sample Bar Showing the Depth A of the Casehardening (Twice Actual Size)

economical use. Some maintain that tools made of this steel should be made in one piece, which obviously entails a great amount of expensive material. There are many instances where a solid tool is the more efficient and economical, and on the other hand, there are just as many instances where a solid tool is pure extravagance. These points will be touched on later.

First-grade carbon steel is particularly suited for hand tools and for finishing purposes. It is especially suited for cutting tools, such as hand reamers, hand taps and dies, shear blades and other tools of a similar kind. The cost of this steel varies from $15 to $18 per 100 lb., and although inexpensive as compared with high speed steel, the cost of solid tools made from it, such as crosshead reamers, knuckle-joint reamers, washout-plug taps and other heavy tools, amounts to a surprisingly high figure. For instance, in a set of eight crosshead reamers the steel figured at 15 cents a pound would aggregate a material expense of $67 alone, not considering the expense of handling the heavy bars, cutting off and getting the stock ready to start the work. By inserting carbon steel blades in soft or machine steel bodies the material cost totals only $16, the labor being slightly in excess of labor costs of machining the solid material. Second-grade carbon steel, which is worth from $10 to $12 per 100 lb., is suitable for other than cutting tools, such as sectional expanders, roller and expander pins, forging dies, etc.

Soft steel ranges in price from $1.55 to $1.75 per 100 lb., and can be used extensively in manufacturing small tools where good case-hardening and heat-treating facilities are available. For cutting purposes it cannot be relied on nor is it recommended. However, for many other purposes it is a very valuable



Size of Reamer	Shank	A	B	C	D	Number Blades
1⅛" to 1¼"	No. 4	2¾	5/32	5/32	1/4	6
1 9/32" to 1½"	No. 4	3	5/32	11/64	5/16	7
1 17/32" to 2"	No. 4	3	5/32	3/16	11/32	8

Fig. 3—Rose Reamers of Soft Steel with High Speed Steel Inserted Blades

material. One instance where it has positively proved superior to tool steel is in the manufacture of flue cutting tools. (See Fig. 1.) This particular tool, when made entirely of tool steel, was a source of much trouble, due to the breaking of the barrel which holds the tool steel cutter. We found that if the barrel was hardened it would snap off when under working strain. If it was used soft it would do the work better, but when the knife broke it would be cut in two by pieces of the knife wedging in between the inside of the flue and the barrel flue cutter. Soft steel, case-hardened and drawn to 450 deg., has overcome this trouble completely and makes a successful tool in every respect. It is, moreover, a much cheaper tool to produce.

For manufacturing flue roller bodies the soft steel has proved equally satisfactory; in fact, it is superior to tool steel, as it has an elastic body, and a hard and tough outer surface. Our practice is to case-harden to about 1/16 in. deep, cool slowly and reheat at 1,600 deg., quench in oil and draw to 450 deg. in an electric furnace. This produces a hard, tough, outer surface and an elastic body. Fig. 2 shows the texture of a piece of machine steel thus treated. Eight and one-half pounds of raw material is required for a complete flue roller for 2 in. flues. If made of second-grade tool steel at $0.12 per pound, the material cost is $1.02 each. If made from soft steel the same tool costs $0.125 for material, which, manufactured in quantities of six dozen shows a saving of $64.80 in material. Moreover, a marked gain is made in machining costs, which just about covers the expense of case-hardening and heat-treating.

The following is a list of tools which we manufacture, util-

izing soft steel extensively: Drill chucks, drill sleeves, drill repair sleeves, drill extension sockets, flue cutter holders, flue roller bodies, steel nuts, equalizer jacks, square sockets. (Morse taper shanks for machine tapping and reaming) rose reamers (high speed steel blades are inserted as shown in Fig. 3), crosshead reamers (inserted first carbon blades), knuckle joint reamers (inserted high speed blades), washout plug taps (inserted carbon steel blades), counterboring tools (inserted high speed blades). and machine tool holders (case-hardened for holding inserted high speed bits).

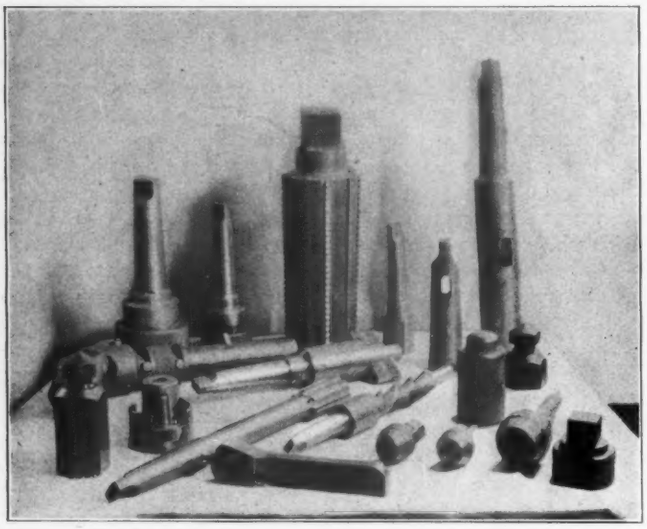


Fig. 4—Group of Tools in Which Casehardened Machine Steel Has Been Used with Success

Fig. 4 shows a group of tools made of soft steel, the more expensive material being inserted.

RESULTS OF THE LOCOMOTIVE BOILER INSPECTION LAW*

BY FRANK McMANAMY
Chief Inspector, Locomotive Boilers, Interstate Commerce Commission, Washington, D. C.

The results so far obtained from the locomotive boiler inspection law are due to a number of reasons, among which are more careful inspection, more prompt repairs and attention to minor defects, investigation and classification of every accident that resulted in injury, with a view to determining the cause and remedying it, and giving publicity to the information collected.

No railroad man with a trace of honesty and a knowledge of conditions and practices prior to the passage of the law can question that, generally speaking, inspections are now made more carefully and more regularly, and repairs are more promptly made, and further that the question of repairs is less apt to be determined by the number of loads in the yard awaiting movement, although unfortunately that is still occasionally considered to be the deciding factor; an illustration being a recent request by a master mechanic to operate a locomotive with 43 broken staybolts a distance of 312 miles, because they needed the power. It must be admitted, however, that such instances are becoming more rare, although we still occasionally find a superintendent or trainmaster who, in spite of the fact that he is at the other end of the division, considers himself a better judge of the condition of a locomotive than an inspector or foreman who is on the ground, and orders it into service regardless of its condition.

*From a paper presented at the March meeting of the Western Railway Club.

The importance of giving attention to minor defects can be shown by a single illustration. During the last fiscal year 18 persons were injured, due to studs blowing out of firebox or wrapper sheets. The practice of repairing leaky studs by caulking, or permitting them to continue in service without repairs, should be discontinued.

I have recently had occasion to read very carefully statements made before Congressional committees at the time the boiler inspection law was pending, to the effect that all boiler explosions were really crown sheet failures due to low water; therefore, were man failures. In order to correct this misapprehension, attention is directed to the records of such accidents since July 1, 1911.

During the year 1914, as compared with 1912, accidents which are usually termed boiler explosions which resulted in injury have decreased 44 per cent, or from 97 in 1912 to 54 in 1914, and the number of killed and injured has decreased 64 per cent, or from 290 to 104. During the same period crown sheet failures due to low water decreased 48 per cent, or from 92 to 48. I am directing attention especially to this class of accidents, first to show that the class of accidents which were said to be unpreventable have been materially reduced, and also because our investigations have shown that by proper application and maintenance of boiler appurtenances they can be still further reduced.

Rule 42 provides that, "Every boiler shall be equipped with at least one water glass and three gage cocks. The lowest gage cock and the lowest reading of the water glass shall be not less than 3 in. above the highest point of the crown sheet." While it may be a compliance with the letter of the law to locate these appurtenances where they can be most easily applied, regardless of their convenience to the enginemen, it is manifestly not a compliance with the intent of the law, and is not conducive to safety, as an improper or inconvenient location may seriously interfere with their proper use. A certain type of locomotive has the water glass located directly behind the engineer and entirely out of sight of the fireman. In other instances glasses are found so obscured by other boiler appurtenances or by an improper shield that it is difficult, and under certain conditions, impossible to see the water level. A recent investigation of a crown sheet failure showed that the cab arrangement was such that the water glass and gage cocks were 9 in. above the engineer's head and that he regularly carried a small keg to climb upon to try the gage cocks. Can it be seriously questioned that such conditions cause accidents, particularly when operating in a busy terminal? Using a shield that obstructs the view of the water glass is also too common. The manner of application is also important, both as to water glasses and gage cocks.

We also find that the manner in which gage cocks and gage cock drippers are applied indicates that the purpose for which they were applied did not receive sufficient consideration. While the application of a dripper is important to prevent the discharge from the gage cocks from scalding anyone in the cab, it should not be located so close to the gage cocks that the nipples extend down into the dripper, preventing enginemen from seeing the discharge, as dripper pipes occasionally become obstructed and fill with water, in which event the sound of water and steam are identical.

Failure of injector steam pipes continues to be one of the most frequent causes of serious accidents, and is the only one which shows an increase during the present fiscal year over the corresponding period for the previous year. To bring out clearly the cause of these failures, the following is a complete list of all that have occurred since July 1, 1914, and which resulted in 1 killed and 15 injured, showing the cause of each:

INJECTOR STEAM PIPE FAILURES, JULY 1, 1914, TO MARCH 1, 1915

1. Collar broke on right injector steam pipe, due to old crack in collar.
2. Steam pipe to left injector blew off where brazed to collar.
3. Injector steam pipe blew off; union nut broke while being tightened

under pressure, due to defective nut and use of improper tools for making repairs.

4. Threads stripped in injector steam pipe union nut while being tightened under pressure; nut too light and threads badly worn.

5. Injector steam pipe blew off; union nut broke while being tightened under pressure.

6. Union to left injector steam pipe blew off, fatally scalding fireman who was attempting to tighten it under pressure; spanner nut too large.

7. Steam pipe to left injector pulled loose at turret connection due to defective brazing and injector not properly braced.

8. Left injector steam pipe collar broke at injector throttle connection; old crack in flange of collar and wrapped with asbestos to stop leak.

9. Injector steam pipe collar broke; defective collar.

10. Injector steam pipe spanner nut broke while being tightened under pressure.

11. Spanner nut on injector steam pipe broke while being tightened under pressure. Nut had been badly damaged previous to accident by use of hammer and set.

12. Injector steam pipe pulled out of collar; improperly brazed.

13. Spanner nut on left injector steam pipe broke while being tightened under pressure; due to use of improper tools.

14. Injector steam pipe broke at brazing.

15. Right injector steam pipe collar broke; defective collar.

16. Injector steam pipe collar broke; defective collar.

The nine failures, four of which were due to poor brazing and five to collar or sleeve breaking, can, I believe, be prevented by extending the pipe through the collar or sleeve and flanging or beading it, thus reinforcing the collar and reducing the strain on it, as the end of the pipe itself will be solidly held in the joint; therefore, it will carry the load. If properly applied in this way, brazing is not necessary, although it can be done if desired. This method of application is at least as cheap as brazing, and defective or improper workmanship can be discovered by inspection, which is impossible with the brazed connection.

There are other results, more or less indirect, but of substantial benefit to the carriers, among which are a reduction in the number of engine failures, as we have numerous records of locomotive performance which show an increase of from 200 to 800 per cent in the miles per failure since the law became effective, which it is admitted is largely due to improved conditions resulting from the stimulating effect of the law. A saving in fuel is another result of the improved conditions brought about by compliance with the requirements, among which are prohibiting the use of flue plugs and providing that boilers must be more carefully washed, and must have all scale removed from them when in the shop for repairs, and that leaks both inside and outside of the firebox must be kept to the minimum.

Failure to properly wash and scale boilers is another evil which had grown to alarming proportions, due perhaps to the fact that washing or scaling a boiler is among the most disagreeable tasks around a shop, and is too often performed by incompetent or indifferent labor not properly supervised. In addition to being one of the chief causes of leaking crown and staybolts, tests have shown that ⅛ in. of scale on heating surfaces results in a loss of approximately 15 per cent of the value of the fuel; therefore, clean boilers mean in addition to increased efficiency a saving in cost of fuel as well as in the cost of repairs.

While it can not be doubted that the remarkable decrease in the number of casualties and the improved conditions noted, as well as many others are a direct result of the operation of the law, I do not wish to be understood as claiming that those who are administering the law are entitled to all credit for the improvement shown. Such results could not have been accomplished without the co-operation of the railroad officers, which we have in a great measure received. However, co-operation does not mean that we should ignore defective conditions and permit locomotives to remain in service in violation of the law, and that will not be done; it does not mean that attempts should be made to conceal defects by making improper inspections or by certifying to reports which do not represent actual conditions.

DISCUSSION

Mr. McManamy also called attention to the desirability of having the opening in the boiler for the bottom water glass fitting above the crown sheet, for if any obstruction occurred in the top connection the gage glass would not drain until the water was below the crown sheet. Cases were mentioned where hostlers and fire-up men used the bottom water glass cock for an indication of a sufficient amount of water for firing-up, and under the above conditions it is evident that there would be no water on the crown sheet. It was also pointed out that the circulation of water through the arch tubes would, if the glass was located near them, influence the height and give a false reading causing racing or a fluctuation of the water in the glass. M. D. Franey stated that he has eliminated the trouble with racing, due to the circulation of the water through the arch tubes, by cutting off the inside ends of the water glass cocks at an angle of 45 deg. In this way there is a shelf below the water glass cock opening that would protect the water just above it from the effect of this circulation. He also stated that it is preferable to insert the gage cocks and water glass connections on sloping boiler heads horizontally rather than at right angles to the boiler sheet.

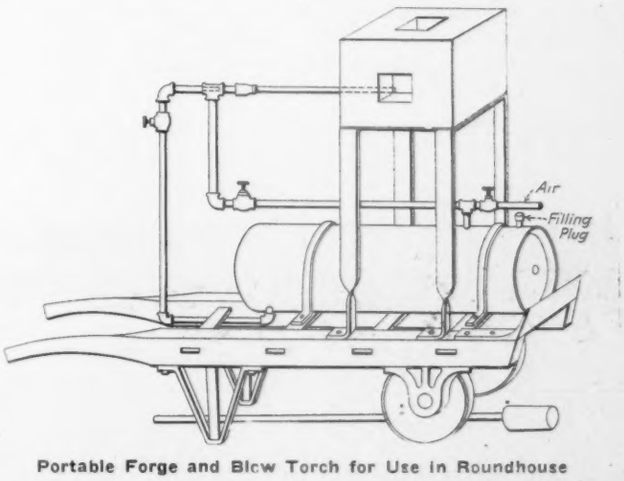
The subject of leveling boilers for the application of gage cocks and water glasses was discussed and the majority of the members speaking on this subject believed that the rubber hose and water glass method was the most satisfactory, the boiler, of course, having been leveled with the frame.

In answer to a question regarding the use of flue thimbles, Mr. McManany stated that the government has made no restriction on their use, that matter being left to the judgment of the men, but if it were found that this practice was being abused, action would be taken concerning that particular case. Regarding the reporting of alterations, he believed that this rule was somewhat misunderstood, and that if the rules were read more carefully much of the unnecessary reporting could be eliminated.

PORTABLE RIVET FORGE AND BLOW TORCH

BY W. S. WHITFORD
General Foreman, Chicago & North Western, Milwaukee, Wis.

The accompanying illustration shows a portable rivet forge and blow torch which was designed by E. J. Nicholson, the boiler foreman at this point, for use in the roundhouse. Fuel oil is used and air can be obtained either from a locomotive



Portable Forge and Blow Torch for Use in Roundhouse

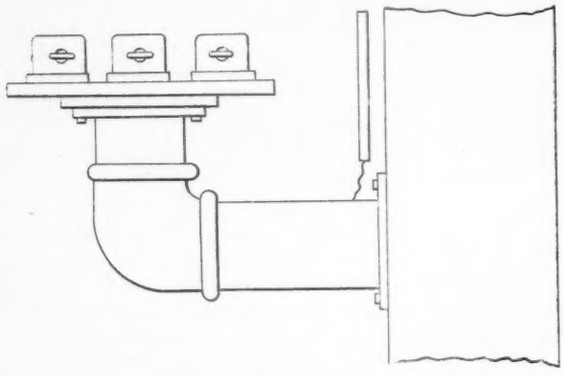
or the roundhouse air line. The forge is made up of a 12 in. by 40 in. air drum securely fastened to an old truck and the fire pot extends up over the drum as shown in the illustration.

The blow torch is very useful in straightening front frames, running board brackets, tank angle irons and heating frames for thermit welds. It is used by unscrewing the small pipe at the reducing bushing which leads to the furnace and attaching a hose leading to the torch. This apparatus is very easily made, and old material can be used. It will pay for itself in a very short time.

POST CLUSTER FOR EXTENSION CORD PLUGS

BY F. W. BENTLEY, JR.

It is often necessary for a number of individual extension lights to be used by men working on the same job in the erecting shop. The illustration shows a plate to which are secured a number of plug boxes to which several extension cords may be attached. By the location of such plates at suitable intervals all extension lights may be attached to plugs near the work, thus providing greater safety than is possible where long cords are



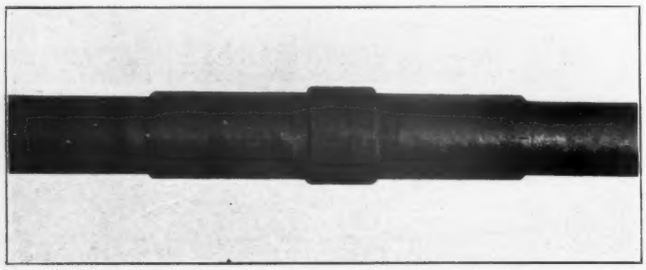
Terminal Boxes for Extension Cord Plugs

used with the connections at some distance from the work. With the long cord there is always the possibility that the plug may be accidentally pulled from the box at a time when failure of the light may result in injury to the user. The support is made of 2-in. pipe through which the wiring is conveyed from the post to the boxes.

USING OLD BOILER TUBES AS PIPE

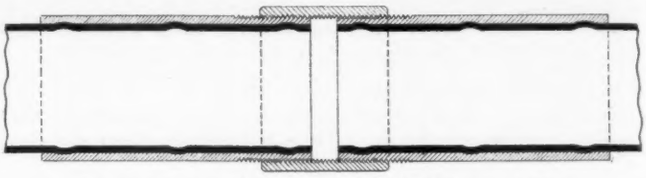
BY J. P. NOLAN
Assistant Superintendent, Morgan's Louisiana & Texas Ry., Algiers, La.

Efforts have been made to make pipe lines for steam, water, air, etc., from old boiler tubes by swaging down the ends of the tubes to pipe size and threading them or by welding short pieces of pipe to the ends of the tube and threading the ends of the



Old Boiler Tubes Joined by Standard Pipe Coupling

pipe. Satisfactory results have not always been obtained by the first method, however, because the worn tubes are often too thin to form a substantial joint after being threaded. The illustrations show an effective means of joining old tubes. A piece of gas pipe about equal in length to twice its outside diameter, one end of which is threaded, is slipped over the end of the tube. A tight joint is made by expanding the tube near each end and in the middle of the pipe with a roller tube expander, care being



Ends of Tubes Expanded into Short Pieces of Pipe

taken not to enlarge the size of the thread by too tightly expanding the tube at these points. In this manner the ends of old tubes may be readily adapted to receive standard pipe fittings and may be used to build substantial pipe lines about the shop.

FIXING STANDARD TIME FOR A BONUS SYSTEM*

The bonus system was established in one department of the Atchison, Topeka & Santa Fe shops, at Topeka, in 1904, by Harrington Emerson. At the beginning an effort was made to establish a really scientific system. Each operation was carefully observed and timed with stop watches and standard tasks were so set.

"In the latter part of the year 1906," says the company's booklet explaining its bonus system, "it was decided by the management from experience thus far gained, that better results would be obtained by adopting the simplified Santa Fe efficiency plan. This simplified plan among other things involved the abandonment of timing operations with stop watches and the installation of a system for fixing rates by a staff of bonus supervisors said to know the work thoroughly. To quote one of the officers of the company "our supervisors have become so proficient that they know by looking at a process the time it should be done in, and they can set the rates more accurately than by using stop watches."

Few reputable efficiency engineers would accept such a statement without much questioning. In fact it seems self-evident that no method of fixing standard time by observation—no matter how skilled the observer—can be as accurate as one in which every movement in the performance of each task is carefully and repeatedly timed under varying conditions. Changes in locomotives and in methods of manufacture are continually producing new jobs which may in part be resolved into certain elements that are common to old operations, and so can be easily adjusted. But especially in repair work, new tasks differing from old ones are constantly coming up, which make necessary new schedules for payment. In the Santa Fe shops these schedules are made by one person who determines what shall be paid. Under these conditions, therefore, there is all the more reason for working out a system for fixing rates that will be precisely fair and just to the men dealt with.

Moreover, under the present plan, which has eliminated the timing of separate parts of each operation, there is not the same opportunity which existed under the earlier plan for each worker to determine the fairness and accuracy of the company's standard by means of testing for himself the time fixed for each part of his task. This is especially important in a shop like those on the Santa Fe where there is no method for collective representation of employees' interests when the process of "standard time" setting is going on.

Men doing their tasks in standard time are said to be 100 per cent efficient and those achieving over 66.7 per cent efficiency earn bonuses according to their output. "At 66.7 per cent ef-

*Extract from a report by Zenas L. Potter of the Department of Surveys and Exhibits, Russell Sage Foundation, on Industrial Conditions in Topeka.

ficiency," the company's explanatory booklet states, "the company acknowledges having obtained value received for the hourly wages paid." The presumption is—and this is in accord with the principles of the bonus system—that those below 66.7 per cent efficiency do not return "value received" for their regular wages. In other words, save for a few who may be exactly 66.7 per cent efficient, those who are unable to earn bonuses must be a direct loss to the company. In an efficiency system those failing to earn bonuses become for this reason subjects for special investigation, and if their failings continue, for discharge.

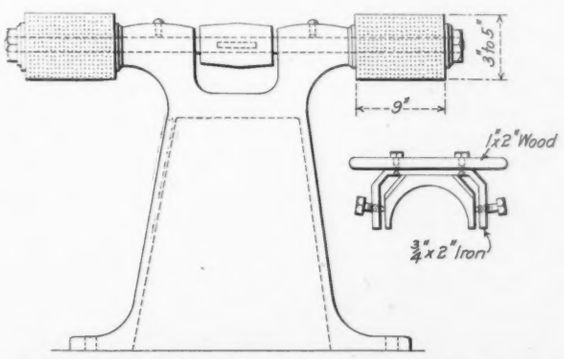
An investigation for the month of October, 1913, showed that while 60 per cent of the workers earned bonuses, 40 per cent did not. If the point where bonus earnings begin marks the point where the company receives value for regular wages, then the great majority of the 541 workers, making up this 40 per cent (except for a few who may have been exactly 66.7 per cent efficient), must have been a direct loss to the company. It is not likely, however, that men whose product is of lower value than their wages would be continued at work, and the presumption must be that 66.7 per cent efficiency does not mark the point at which the company gets "value received" for regular wages. Thus it appears that the methods of fixing the task which the workers must perform before beginning to earn bonuses is neither accurate nor scientific.

Another fact was brought out. The percentage of men able to earn bonuses varies greatly from trade to trade. Only 50 per cent of the boiler makers, for instance, 45 per cent of the pipefitters, and 37 per cent of the car repairers, as against 100 per cent of the cabinet makers, 97 per cent of the painters, and 89 per cent of the blacksmiths were able to make this extra pay. These very wide variations indicate that "standard time" has not been adjusted so as to reward equally relative equality of skill in the different trades and suggests that methods for fixing standards are far from being accurate or scientific.

FINISHING CAR AND ENGINE TRUCK BRASSES BY GRINDING

BY R. E. BROWN,
Machine Shop Foreman, Atlantic Coast Line, Waycross, Ga.

An economical method of preparing car and engine truck brasses for babbitting is in use at the Waycross shops of the Atlantic Coast Line. The brass patterns have all been made to finished size and the rough castings, instead of being bored, are taken to an emery wheel where all scale is ground away from the circle of the brass, leaving the bright, clean metal



Grinding Wheel for Finishing Car and Engine Truck Brasses

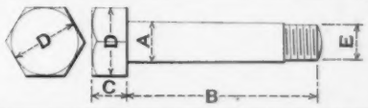
exposed. The brasses are then spotted on both sides of the center with one-half inch holes, filled to a depth of one-quarter inch from the drill point. They are then placed upon a form and babbitted. This method has been in use for more than a year with excellent results, and the cost of doing the work is much lower than by the old method of boring all brasses. The wheels used are five inches in diamter by nine inches long and are mounted on a double wheel stand as shown in the drawing. A simple device is used for handling the brass while it is being ground and is readily attached to and removed from the brass by means of two set screws. By this method an unskilled helper is able to finish from 25 to 30 brasses in an hour, whereas when boring the brasses the output of a mechanic was about 12 per hour.

TURNING ENGINE BOLTS

BY C. L. DICKERT
Assistant Master Mechanic, Central of Georgia, Macon, Ga.

A system of standard engine bolts and reamers has been adopted by the Central of Georgia, and a machine tool group installed at the Macon shops especially for the manufacture of bolts on shop orders for stock.

Bolts are made on shop orders in quantities of from 2,000 to 6,000, ranging in sizes as shown in the accompanying table. Occasionally small lots are made to fill in where the most used sizes in stock have been reduced. The diameter of the stand-



Bolt Number to be size of bolt under head in 32nds.

Bolt Number	Finished Sizes					Forging Sizes			
	Diam. Under Head A	Length Under Head B	Thickness of Head C	Across Flats D	Diam. of Threads E	Diam. Under Head A	Length Under Head B	Thickness of Head C	Across Flats D
26	13/16	4, 6, 9, 12	5/8	1 1/4	3/4	1	4, 6, 9, 12	23/32	1 5/16
27	27/32	4, 6, 9, 12	5/8	1 1/4	3/4	1	4, 6, 9, 12	23/32	1 5/16
28	7/8	4, 6, 9, 12	5/8	1 1/4	3/4	1	4, 6, 9, 12	23/32	1 5/16
29	29/32	4, 6, 9, 12	5/8	1 1/4	3/4	1	4, 6, 9, 12	23/32	1 5/16
30	15/16	4, 6, 9, 12	23/32	1 7/16	7/8	1 1/8	4, 6, 9, 12	13/16	1 1/2
31	31/32	4, 6, 9, 12	23/32	1 7/16	7/8	1 1/8	4, 6, 9, 12	13/16	1 1/2
32	1	4, 5, 6, 9, 12	23/32	1 7/16	7/8	1 1/8	4, 5, 6, 9, 12	13/16	1 1/2
33	1 1/32	4, 5, 6, 9, 12	23/32	1 7/16	7/8	1 1/8	4, 5, 6, 9, 12	13/16	1 1/2
34	1 1/16	4, 5, 6, 9, 12	13/16	1 5/8	1	1 1/4	4, 5, 6, 9, 12	29/32	1 11/16
35	1 3/32	4, 5, 6, 9, 12, 15	13/16	1 5/8	1	1 1/4	4, 5, 6, 9, 12, 15	29/32	1 11/16
36	1 1/8	5, 6, 9, 12, 15	13/16	1 5/8	1	1 1/4	5, 6, 9, 12, 15	29/32	1 11/16
37	1 3/32	5, 6, 9, 12, 15	13/16	1 5/8	1	1 1/4	5, 6, 9, 12, 15	29/32	1 11/16
38	1 1/16	5, 6, 9, 12, 15	29/32	1 13/16	1 1/8 , 1	1 3/8	5, 6, 9, 12, 15	1	1 7/8
39	1 3/32	5, 6, 9, 12, 15, 18	29/32	1 13/16	1 1/8 , 1	1 3/8	5, 6, 9, 12, 15, 18	1	1 7/8
40	1 1/4	5, 6, 9, 12, 15, 18	29/32	1 13/16	1 1/8 , 1	1 3/8	5, 6, 9, 12, 15, 18	1	1 7/8
41	1 3/32	5, 6, 9, 12, 15, 18	29/32	1 13/16	1 1/8 , 1	1 3/8	5, 6, 9, 12, 15, 18	1	1 7/8
42	1 5/16	5, 6, 9, 12, 15, 18	1	2	1 1/4 , 1 1/8	1 1/2	5, 6, 9, 12, 15, 18	1 3/32	2 1/16
43	1 11/32	6, 9, 12, 15, 18	1	2	1 1/4 , 1 1/8	1 1/2	6, 9, 12, 15, 18	1 3/32	2 1/16
44	1 3/8	6, 9, 12, 15, 18	1	2	1 1/4 , 1 1/8	1 1/2	6, 9, 12, 15, 18	1 3/32	2 1/16
45	1 13/32	6, 9, 12, 15, 18	1	2	1 1/4 , 1 1/8	1 1/2	6, 9, 12, 15, 18	1 3/32	2 1/16
46	1 7/16	6, 9, 12, 15, 18	1 3/32	2 3/16	1 3/8 , 1 1/2	1 5/8	6, 9, 12, 15, 18	1 1/16	2 1/4
47	1 15/32	6, 9, 12, 15	1 3/32	2 3/16	1 3/8 , 1 1/4	1 5/8	6, 9, 12, 15	1 1/16	2 1/4
48	1 1/2	6, 9, 12, 15	1 3/32	2 3/16	1 3/8 , 1 1/4	1 5/8	6, 9, 12, 15	1 1/16	2 1/4
49	1 17/32	6, 9, 12, 15	1 3/32	2 3/16	1 3/8 , 1 1/4	1 5/8	6, 9, 12, 15	1 1/16	2 1/4

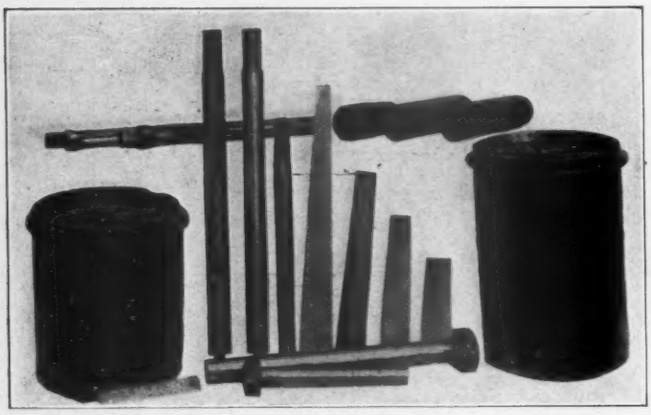
Standard Taper Bolt Sizes Used on the Central of Georgia

ard bolts under the head varies by 32nds from 13/16 in. to 1 17/32 in., and each size is designated by the number of 32nds in its diameter. The standard lengths range from 4 in. to 18 in.

All reamers are sized and marked at the large end, to correspond with the size of the bolt under the head, so that both can be ordered according to the size of the reamer. With this arrangement the hole is reamed to suit the bolt, and only in special cases where it is difficult to ream, is the bolt fitted to the hole.

The bolts are largely carried in store stock. However, in the erecting shop suitable bins are provided for a small number of

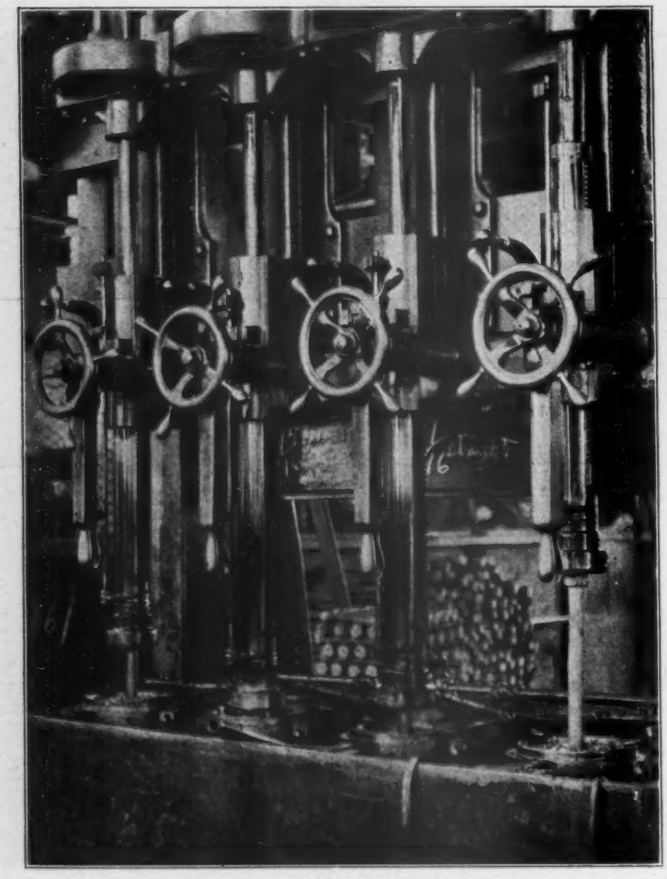
each size. Frequently only one or two bolts are needed and this saves special trips to the store house in such cases. When a number of bolts are needed for bolting up cylinders, new frames, etc., they are drawn from the store, cut to length,



Cutter Heads, Blades and Gages for Adjusting the Heads; Hollow Gages for Testing Turned Bolts

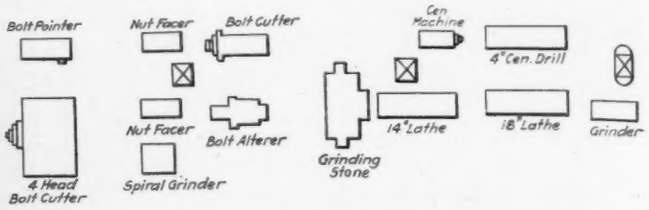
threaded, and placed at the engine where the machinist reams the holes and drives them in.

The group of machine tools devoted to the finishing of bolts is made up of one 3-in pointer, a 4-spindle bolt turner, a bolt alterer, one triple head bolt cutter, one 14-in. and one 16-in. engine lathe, two center drills, and two nut facers. One of the illustrations shows a pile of rough bolts as received from the bolt header. They are first pointed in order that they will properly enter the cutter head of the bolt turning machine.



Four-Head Bolt Turning Machine

This has four heads and is shown in one of the illustrations. The cutter heads are located in the base of the machine, and the bolts are driven into them by revolving spindles. The cutter heads are fitted with removable blades which are adjusted for diameter and taper by means of plug gages. A set of hollow gages are also provided by which the turned bolts may be tested both as to the correctness of size and taper. The bolts are finished with one cut, no roughing cut being necessary, the average time required being less than one and one-half minutes for each bolt. When all four heads are working a 1 in. by 12 in. bolt is turned in one minute.



Group of Machine Tools for Finishing Engine Bolts

Bolts with countersunk and counterbored heads are made from the standard stock hexagonal head engine bolts. These operations are performed on the bolt altering machine which has two sliding heads operated by a hand lever giving a quick movement of tools. By this means two apprentices are able to more than keep ahead of special bolt fitting. Bolts are cut off to length in this machine and threaded on the bolt cutter.

Rough Bolts Ready to Be Pointed

All bolt machines, except the two bolt lathes, are operated by cheap labor, thus bringing the cost of bolt turning and fitting to a minimum.

Cactus as a Binder.—The United States Patent Office has recently granted a patent to F. Meyer, of Denver, Colo., on a new binder for briquetting coal dust, coke breeze, flue dust and fine ores. The binder is the liquid extract of cactus, and its wide occurrence in all the southwestern states and its almost absolute uselessness for other purposes ought, according to the patentee, to furnish a binder cheaper than any other mentioned in the various publications of the Bureau of Mines on the subject of briquetting of fuel. There can be no doubt that cactus has excellent binding qualities. Any one who has ever had the misfortune to experiment with cactus knows that its pulp is as sticky as glue, and we also know that the extract of *Cactus opuntia* is often used as a substitute for tragacanth by confectioners.—*Engineering & Mining Journal.*

ANSWERS TO SOME QUESTIONS ON ELECTRIC ARC WELDING*

BY J. F. LINCOLN

The available literature on arc welding is very incomplete, and gives but little information to the man who might apply arc welding to his product. The object of this paper is to consider the fundamental principles of arc welding so that the manufacturer can decide for himself the following questions:

1. What metals can be welded by the electric arc?
2. What difficulties are encountered in electric arc welding?
3. What is the strength of the weld in comparison with the original piece?
4. What is the cost of welding?
5. What is the function of the arc welding machine?
6. How does electric welding compare with oxy-acetylene and other similar methods?

All metals can be welded. Any two pieces of metal which are brought into contact at their melting temperature will adhere so that they are no more liable to break at the point of junction than at any other point. The electric arc is used in the process merely as a heating agent, and this is its only function. It is superior to any other method of heating because of its ease of application and the economy with which heat can be concentrated at any given point by its use.

The difficulties which are encountered in welding are the following: Formation of oxide; expansion and contraction under heat; burning through. In the case of brass or zinc, the heated parts will be covered with a coat of oxide before they come to a welding temperature. This makes it impossible for two clean surfaces of the metal to come into intimate contact. Some method must be adopted for disposing of this oxide at the weld and allowing the two surfaces to be welded to come together without the possibility of oxide being included between them. This condition obtains in the welding of aluminum and of a great many alloys. In order to eliminate this coat of oxide it is usually necessary to puddle the weld, that is, to have enough of the metal melted at the weld so that the oxide is floated away from it. When this is done, the two surfaces are covered by a coat of melted metal on which the oxide floats, thus allowing two clean surfaces of metal to come together. This precaution, however, in the case of steel is not usually necessary.

Another difficulty with arc welding is that very thin pieces of metal are very liable to burn through, leaving holes where the weld should be. This difficulty can be avoided by backing up the weld with a metal face to carry away the heat, or by decreasing the intensity of the arc so that the melting through will not occur. The limiting thinness of metal to which arc welding can be applied without metallic backing is approximately 22 gage.

The next difficulty with arc welding is the lack of skillful operators. Manufacturers sometimes do not give the operators a chance to master the process before making up their minds that the method is not feasible. If the same point of view were held in regard to welding by means of the forge fire, blacksmithing would never have come to be practiced. It does not require as skillful handling to make a good arc weld as it does to make a weld on an anvil, and there are very few electric welds that cannot be handled successfully by an operator of average intelligence with one week's instruction.

The strength of the weld is equal to that of the metal of which the weld is made. It should be remembered, however, that the metal which goes into the weld is really a casting, and has not been rolled. This means that the strength of the weld would be equal to that of the same metal that is used for filling, if used in the form of a casting. There are a great many welds where it is possible to make the section at the weld a little larger than the section of the rest of the piece. The disadvantage of the weld being in the form of a casting can thus be overcome.

There are no doubt some cases where the use of a drop hammer and a forge fire and the oxy-acetylene blow torch will make, all things considered, a better job than the use of the electric arc. However, the electric arc will melt metal in a weld for from 3 to 30 per cent of the cost of melting it with the oxy-acetylene blow torch, on account of the fact that the heat can be applied exactly where it is required, and in any amount that is required.

It is practically out of the question to apply the alternating current to arc welding since one electrode must always remain positive. In welding by means of the carbon arc, the piece to be welded is made the positive electrode, while with a metallic arc either the piece to be welded or the filler may be made the positive electrode. With a carbon electrode the voltage will vary from 0 to 45 volts; with the metallic electrode from 0 to 30 volts.

The simplest welding machine is an ohmic resistance in series with the arc. This is entirely satisfactory except in regard to the cost of current. By the use of resistance in series with the arc on a 220-volt supply circuit, from 80 to 90 per cent of the current is dissipated as heat in the resistance.

Practically all arc welding machines now in use consist of motor-generator sets, the motor of which is adapted to the existing supply circuit, and is direct connected to a compound-wound generator delivering current at approximately 75 volts, which is applied to the arc in series with a resistance. Considerable saving is effected by this method over the use of a resistance in series with the full supply voltage. It is possible to construct a machine that will eliminate these losses by avoiding the use of a resistance in series with the arc. A machine of this kind will save its cost in a short time, provided it is in steady use.

The following figures give the approximate cost of power for operating arc welding machines under average conditions, which are assumed as follows: Cost of current, 2 cents per kw-hr.; metallic electrode arc of 150 amperes; carbon arc of 500 amperes; voltage across the metallic electrode arc 20; voltage across the carbon are 35; supply circuit 220 volts direct current; a single resistance in series with the arc. With the metallic electrode, the cost of energy will be 66 cents per hour; with the carbon electrode $2.20 per hour. If a motor-generator set with a 75-volt constant potential machine is used for a welder, the cost will be for the metallic electrode 25.2 cents per hr., and for the carbon electrode 84 cents per hour.

With a machine which will deliver the required voltage at the arc without the use of a series resistance the cost will be for the metallic electrode, 7.2 cents per hour, and for the carbon electrode 42 cents per hour. These figures assume that the arc is held continuously at its full value. This condition, however, is impossible in practice, and the actual load factor is approximately 50 per cent, which means that, as a welder is usually operated, the actual cost of operation will be about one-half of the amounts given above.

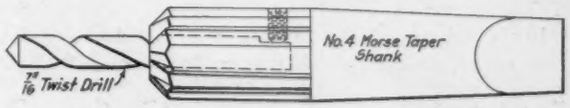
*Abstract of a paper read before the American Institute of Electrical Engineers, Cleveland, Ohio, March 18-19, 1915.

FINISHING CYLINDER COCKS

BY R. E. BROWN

Machine Shop Foreman, Atlantic Coast Line, Waycross, Ga.

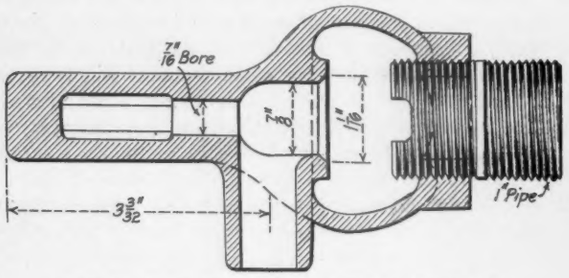
A cylinder cock body in use on the Atlantic Coast Line is shown in one of the accompanying drawings. A special drill and reamer and a pneumatic chuck are used in finishing the



Combination Tool for Finishing Cylinder Cocks

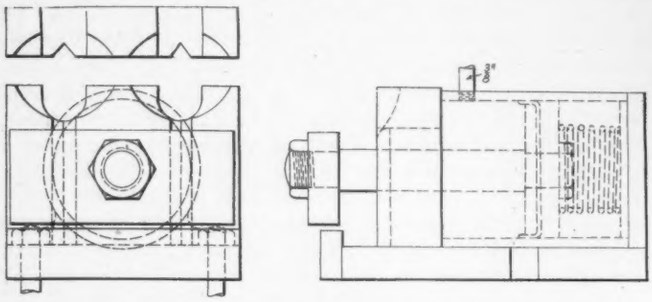
valve seat, valve stem guide and threaded connection of the cylinder cock. The chuck consists of an angle plate back of which is an air cylinder by means of which the castings are clamped in position. Recesses in the face of the chuck con-

form to the cylinder cock bodies so that they are held rigidly in position. Two castings are chucked at one time and are finished with the combined drill and rose bit reamer shown in one of the illustrations. The reamer is provided with a recess in



Cylinder Cock Used on the Atlantic Coast Line

the end in which is inserted a 7/16-in. twist drill, a small set screw in the reamer holding the drill shank in place. The drill finishes the valve stem guide and the reamer faces the valve seat and finishes the threaded connection at the top of the cylin-



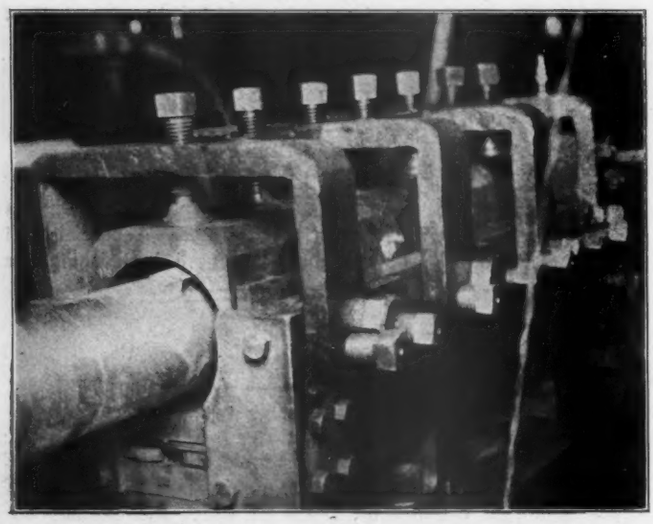
Chuck Used With Atlantic Coast Line Cylinder Cock

der cock body. After the reaming operation is completed the threads are tapped, both operations being done on a drill press by a handyman, who can finish about 25 castings per hour.

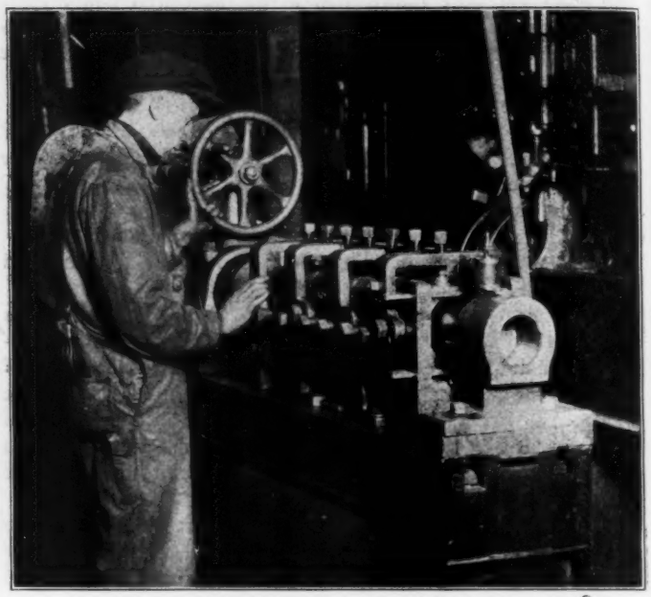
BORING FRONT END MAIN ROD BRASSES

BY C. H. ANDRUS
Master Mechanic, Pennsylvania Railroad, Harrisburg, Pa.

The jig shown in the illustration was developed and applied to an obsolete horizontal boring mill to increase the output and reduce the cost of finishing front end main rod brasses. By its use seven sets of brasses are finished at one time. They are entered at the end of the jig, set in position with liners and securely clamped at the top and sides by set screws with swivel ends. They are then finished with a roughing and a finishing cut. In this way seven sets of brasses can be set up, lined and clamped in position, the two cuts made and the brasses removed from the



Jig for Boring Front End Main Rod Brasses



Front End Main Rod Brasses Set Up in Old Horizontal Boring Mill

machine in 21 min. With the former practice of finishing the brasses on a lathe, one set at a time, to finish seven sets required 13 hr. The work of this machine has proved very satisfactory.

SPECIAL CHUCKS FOR A TURRET LATHE

BY W. W. ELFE
Machine Foreman, Central of Georgia, Macon, Ga.

The illustration shows three chucks designed for use in turning and threading front end main rod keys and fire door latches on a turret lathe. The body of each chuck is designed to fit the body of the piece to be machined, leaving the end to be threaded

Chucks for Threading Fire Door Latches and Front End Main Rod Keys in a Turret Lathe

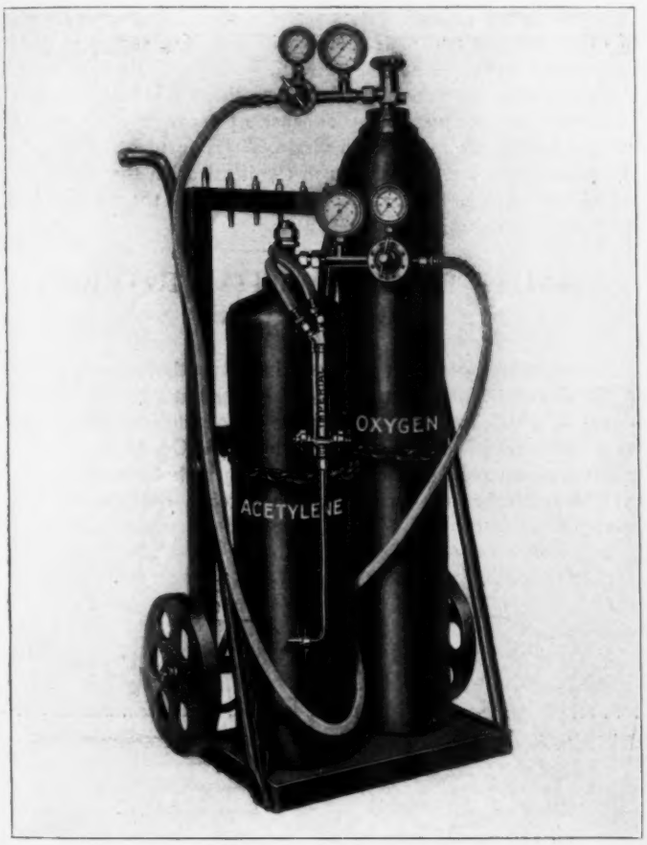
projecting beyond its face. When in position the work is secured by means of the set screws shown in the illustration. The chucks are provided with cylindrical shanks by means of which they are held in the automatic chuck of the turret lathe.

Manganese Ore.—Russia's export of manganese ore for the first nine months of 1914 were 737,149 tons against 817,345 tons for the same period in 1913. Imports of coke were 512,000 tons to October 1, 1914, compared with 687,000 tons in the same period in 1913.—*Iron Age.*

NEW DEVICES

OXY-ACETYLENE EQUIPMENT

Among the considerations of special importance in oxy-acetylene welding or cutting are the thorough and uniform mixing of the two gases employed and the close regulation of both the volume and velocity of the gases delivered to the mixing chamber of the torch. In the oxy-acetylene equipment recently placed upon the market by the Imperial Brass Company, 528 South Racine avenue, Chicago, the principle on which the oxygen and acetylene are mixed assures a high degree of uniformity in the mixture as it leaves the torch. Before entering the mixing chamber the oxygen at high velocity passes through



Portable Oxy-Acetylene Welding Equipment With Interchangeable Tips

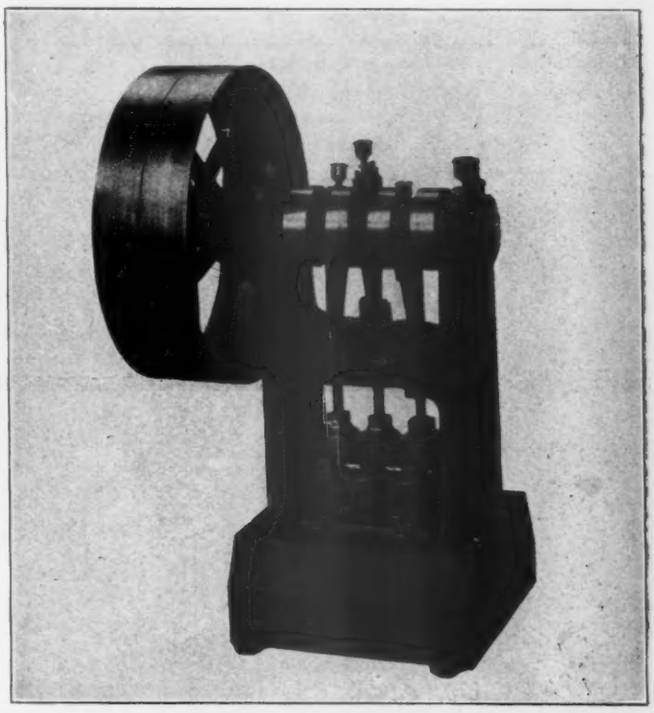
a spiral groove which imparts to it a whirling motion. This causes the oxygen to mix thoroughly with the acetylene and effects a uniform mixture of the gases before they reach the point of combustion. The result is claimed to be a saving in oxygen and a flame of greater intensity both with the welding and the cutting torches.

The Imperial torches are fitted with interchangeable tips which are designed to cover all ranges of work within the limit of the oxy-acetylene process. The torches are durable in construction, no solder being used in their construction. The gas mixture is controlled by needle valves which admit of fine adjustment and are so located that the operator may readily adjust the flame with the hand which holds the torch, making it unnecessary to lay aside the welding stick. Both welding and cutting tips are made of a special alloy with an extremely high melting point and all threads and other dimensions are standard. New tips for temporary use can readily be made in any machine shop from ordinary rod brass, so that the torch can be kept in service until new tips are secured.

The pressure regulators included in this equipment are designed to deliver to the torch a constant predetermined volume of gas at a constant velocity, and the movement of the valve with relation to its seat is so limited as to prevent cutting of the seat, thus insuring long life. The regulators are designed to automatically shut off in case of emergency.

SMALL SINGLE ACTING HYDRAULIC PUMP

To meet the demand for an inexpensive hydraulic pump delivering a small quantity of water and still capable of exerting a high pressure, the pump shown in the illustration was designed by the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio. It is especially adapted to service requiring a steady, uniform flow of a small quantity of water under high pressure. On account of its light weight, when motor driven, it may be mounted on a truck and be used as a portable pump for operating small hydraulic shop tools on which no pump is mounted. It is provided with a knock-out attachment which automatically cuts off the delivery of water to the press ram, but maintains the pressure when a predetermined maximum pressure is reached. A slight drop in the pressure automatically starts the flow, which continues until the maximum pressure is again reached. The base of the pump forms a reservoir for the liquid used in its operation. It is built for either gear, chain or belt drive.



Small Single Acting Triplex Pump

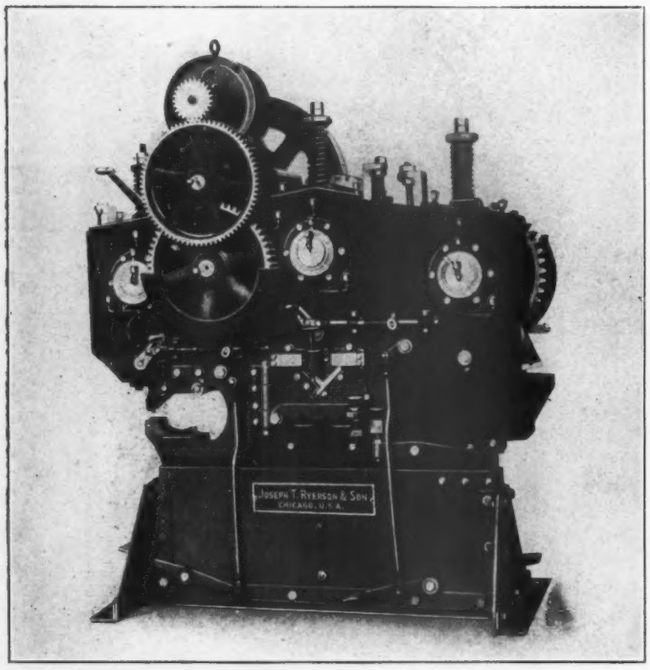
The design of this pump is such that any one of twelve different size plungers may be furnished. These range from 3/16 in. to 1 in. in diameter, advancing by increments of 1/16

in. The maximum pressure which may be obtained ranges from 750 lb. to 8,000 lb. per sq. in., the larger the plunger diameter the lower the pressure capacity. The pump is single acting. The three plungers are of the same diameter and work to the same maximum pressure. The stroke is 2¾ in. Each plunger has a speed of 35 ft. per min. at 150 strokes per min., which is the rated speed. When driven at this speed the pump has a capacity of .41 gal. to 4.20 gal. per min., depending upon the diameter of the plungers. The suction and discharge valves are located in the pump cylinder.

The frame is cast in one piece of semi-steel; the cross heads are of cold rolled steel. The connecting rods are made of malleable iron with bronze bearings. The pump plungers are naval bronze, with the exception of the 5/16 in. and ⅜ in. sizes, which are of steel, to withstand the high pressure, and with which forged steel cylinders are used. Other sized cylinders are cast en bloc, for plunger diameters larger than ⅜ in., a special bronze being used. The pump has a height over all of 35 in. and occupies a floor space of 16 in. by 18 in. The weight without motor base or belt shifter is only 500 lb.

QUINTUPLE PUNCHING AND SHEARING MACHINE

To meet the demand for a combination machine that will handle the punching, shearing and notching work met with in structural shops, car shops and ornamental iron working shops, the machine shown in the illustration was recently developed by Jos. T. Ryerson & Son, Chicago. This machine embodies the functions of five metal working machines in one. It handles punching, shearing, coping notching operations on plates, bars and structural sections without the necessity of interchanging



Combination Punching and Shearing Machine

any attachments. The punch and bar cutter as well as the splitting shear may be operated independently by clutches which may be thrown in either by hand or foot.

The frame of the machine consists of a solid steel offset shear body, the construction of which permits the cutting of plates of any width or length. An adjustable hold-down is provided with the splitting shear. The bar cutting device is provided with an arrangement which permits the shearing of angles and tees as well as both round and square bars without changing the blades. The shape of the upper blade for shearing angles and tee-bars is such that small and light sections may be cut without bending. The stationary blades of the bar and angle cutter are mounted in a hinged frame which may be swung back from the side of the machine permitting easy removal of the blades for grinding. The shear blades are each made in four sections instead of one which greatly simplifies maintenance. Adjustable hold-downs permit the cutting of various material to a perfect right angle and a special attachment is provided which permits intercutting up to an angle of 45 deg.

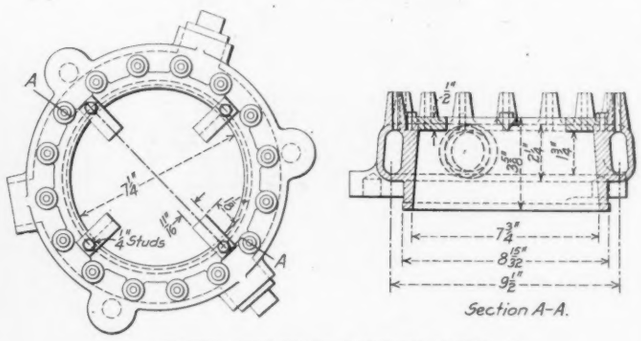
The punch is equipped with the standard architectural jaws, which permits the punching of I-beams and channels, both in the flanges and in the web. A patented centering device is furnished which permits the centering of the punch to the full length of the stroke. The material is stripped from the punch by a universal hold-down. The splitting shear is provided with an extension to the sliding head which receives the die blocks for coping and notching work. This is of rectangular shape and permits not only the coping of light I-beams and channels, but the notching of other sections and material used in stair, fire escape or other ornamental work.

This machine is especially adapted to shops which do not have sufficient work to justify the expense of separate tools for the various operations referred to above. It is furnished for either belt or motor drive. As shown in the illustration the direct motor driven machine is provided with a bracket at the top to which the motor is secured.

EXHAUST NOZZLE WITH INTERNAL PROJECTIONS

A new design of exhaust nozzle has recently been developed in the Pennsylvania locomotive testing plant at Altoona, Pa., by means of which considerable increase in locomotive capacity has been effected. It has been patented by F. A. Goodfellow.

The new nozzle has a circular opening with four projections of triangular section, each of which extends out 1⅛ in. from



Internal Projection Exhaust Nozzle

the periphery of the opening, and is 11/16 in. in width at its top face. The projections diminish the area of the opening 3.44 sq. in. in the nozzle shown in the drawing. They are machined to size and fastened in place with studs so that the apex of each piece points in a downward direction, but will be drop forged in the future, thus saving the cost for machining; they will also be fastened permanently in place by electric welding. This will make it impossible to either increase or decrease the size of the opening without breaking off the welded projections and will eliminate the tendency to make unauthorized changes in the size of standard nozzles. In making up a nozzle of this type, it has been the practice to bore the circular nozzle for the particular class of locomotive on which it is to be tried, ¼ of an inch larger than the specified diameter. The projections are then made to give an area equal to the difference between specified and bored out areas. This method reduces the cost of applica-

tion to a minimum and does not necessitate the making of a new nozzle.

The purpose of the projections is to break up the continuity of the circular section of the exhaust jet and change it to a Maltese cross form, thereby increasing the gas entraining capacity of the jet and creating a greater vacuum in the front end. The nozzle is fastened to the exhaust stand without attention to the angular location of the projections relative to the axis of the front end as experiments have proved that alterations in this location do not affect the performance.

A number of tests were made in the locomotive testing plant at Altoona of both the standard circular nozzle and the internal projection nozzle on engines of three classes, in each case the only change made on the locomotives being the change in exhaust nozzles. These engines* were an Atlantic, E 6s, a Pacific, K 4s, and a Mikado, L 1s.

The following table gives a comparison of the maximum results which were obtained from the locomotives when using each

Type of locomotive	Atlantic		Pacific		Mikado	
Kind of nozzle	Four internal projections	Circular, 6.25 in. diameter	Four internal projections	Circular, 7 in. diameter	Four internal projections	Circular, 7 in. diameter
Area of nozzle, sq. in.	30.86	30.68	38.19	38.45	38.08	38.45
Speed, m. p. h.	46.9	47.0	47.3	37.8	28.3	29.3
Actual cut-off, in per cent	52.0	46.0	60.3	46.4	60.8	51.1
Average boiler pressure, lb. per sq. in.	204.9	184.8	201.3	202.2	204.7	204.4
Draft in smokebox, in. of water	15.1	8.3	18.8	5.7	14.9	8.6
Draft in ashpan, in. of water	0.40	0.41	0.71	0.51	0.60	0.64
Dry coal fired per hr., lb.	8,271	6,942	11,813	5,146	9,312	6,621
Dry coal per sq. ft. grate	148.3	124.4	170.6	74.3	133.0	94.6
Water evap. per hr., lb.	44,628	35,928	65,400	39,977	59,508	46,170
Equiv. evap. per hr., lb.	58,641	46,771	87,414	51,842	79,675	58,539
Superheat, deg. Fahr.	204.2	175.9	215.2	157.2	183.5	122.2
Indicated horsepower	2,304.8	1,901.1	3,183.9	2,241.5	2,835.5	2,366.7

of the two nozzles. A wide open throttle was used in each instance and the working pressure of all the boilers was 205 lb. per square inch.

It will be observed that a much better performance in general was obtained from each of the locomotives when using the new type of nozzle, and especially is this true in the case of the Pacific and Mikado types of locomotives, both of which have boilers similar in design. The Pacific type locomotive delivered an equivalent evaporation of 87,414 lb. per hour and 3,183.9 indicated hp., with the four internal projection nozzle, while with the standard 7 in. circular nozzle it was possible to obtain but 51,842 lb. equivalent evaporation per hour and 2241.5 indicated horsepower. The Mikado type locomotive, having smaller drivers and a longer stroke, developed 79,675 lb. equivalent evaporation per hour compared with 58,539 lb. obtained with the circular nozzle, and 2,835.5 indicated horsepower or an increase of 469 i. hp. above what was developed with the use of the 7 in. circular nozzle. Comparing the performance of the Atlantic type locomotive when equipped with each of the two nozzles, there was obtained with the four internal projection nozzle an increase in equivalent evaporation of 24.2 per cent and 14.6 per cent greater indicated horsepower.

The considerably higher front end draft obtained with the new type of nozzle in each instance, is responsible for the remarkable results attained, enabling the maintenance of a much greater rate of combustion and permitting a higher degree of superheat to be obtained.

LILLE'S LOCOMOTIVES.—Lille is one of the biggest engineering centers in France, and the work shops must have been of considerable use to the Germans. The great Fives-Lille works are well known for the construction of locomotives and bridges, and have supplied an enormous amount of the equipment that has been required for France's railway projects in her African colonies.

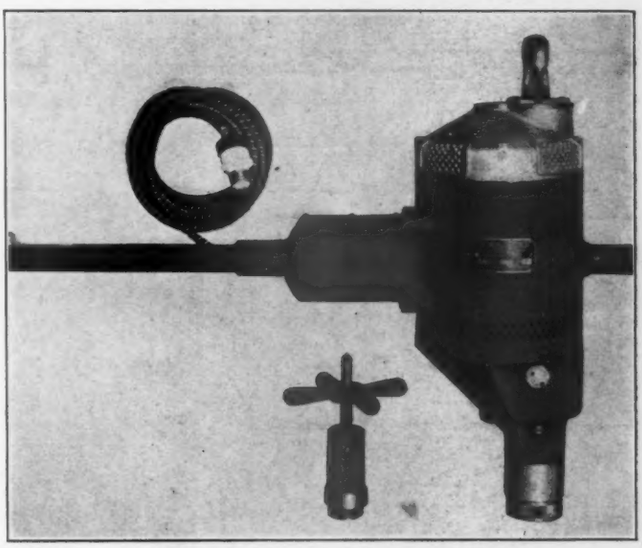
*For descriptions of these locomotives see the following numbers of the *Railway Age Gazette, Mechanical Edition:* E6s, page 63, February, 1914; K4s and L1s, page 343, July, 1914.

HEAVY DUTY ELECTRIC REAMER

A heavy duty reamer of a new design, for use on direct current circuits only, has been brought out by The Cincinnati Electrical Tool Company, Cincinnati, Ohio. It is designed for bridge work, large shop and construction work of all kinds, and is made in three sizes for reaming holes 15/16 in., 1 1/16 in. and 1 3/16 in. respectively.

The motor is of the series wound four pole type, and is completely enclosed. It is air-cooled by means of a fan mounted on the armature shaft. The housing and gear case is of steel, giving special strength and insuring the best of electrical performance. The gears are made of chrome nickel steel. They are mounted on roller bearings and are fully enclosed in the lower head of the reamer. They revolve in grease and are separated from the motor housing by means of a plate which prevents oil and grease from getting into the windings. High grade annular bearings are used on both ends of the armature shaft. The spindle thrust is taken up by means of a thrust ball bearing.

The switch is of the quick make and break type, with release lever in one side handle. It is simple in construction and is guaranteed against overload. The brush holders are mounted on fiber blocks and are highly insulated. The binding posts



Electric Reamer for Heavy Work

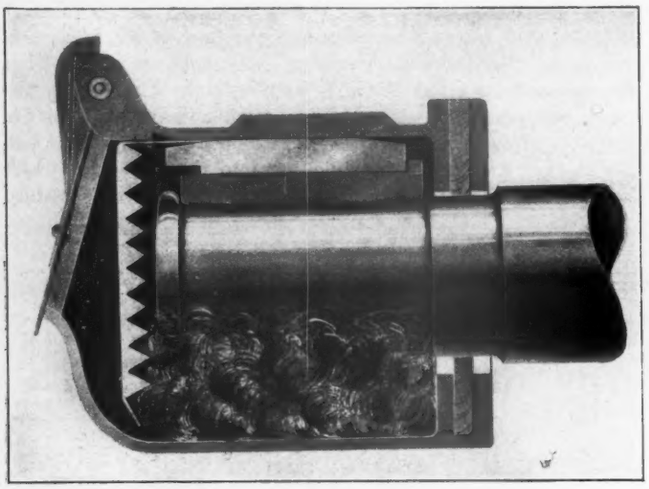
which hold the leads are specially designed to secure contact by means of compression springs, doing away entirely with the use of nuts and screws, and preventing the latter from loosening and lodging in the motor. The brushes are readily accessible by means of four removable window guards and can be replaced instantly without removing the cap or disturbing any part of the machine.

The reamer is equipped with special type of slip socket which

does away with the drift key and drift holes in the spindle and prevents dirt and grease getting into it.

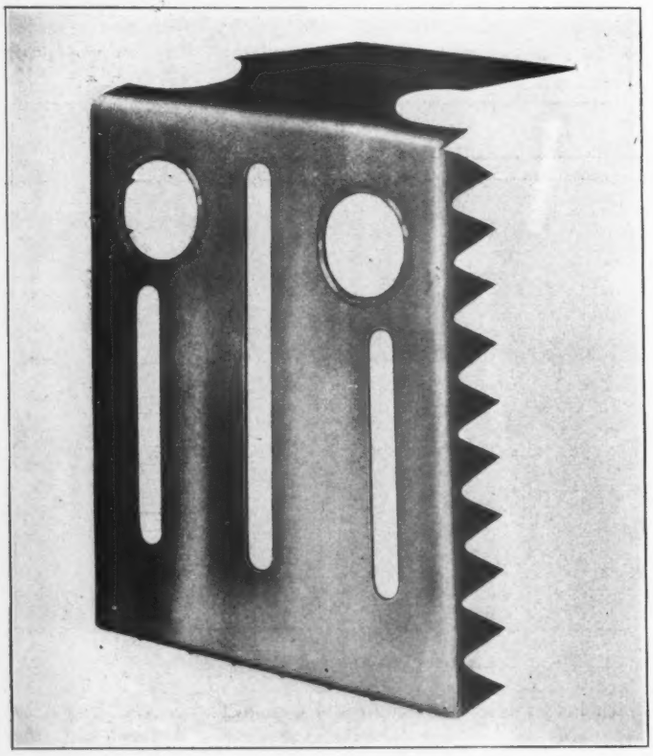
JOURNAL BOX PACKING GUARD

A packing guard for use in journal boxes, which holds the packing under the lid and the box has been placed on the market by the Nuway Packing Guard Company, Tuscaloosa, Ala. It



Packing Guard in Position in the Journal Box

is formed from No. 14 gage steel with teeth extending back from the sides and bottom. A tongue extends back from the top of the guard, by means of which it is secured in the



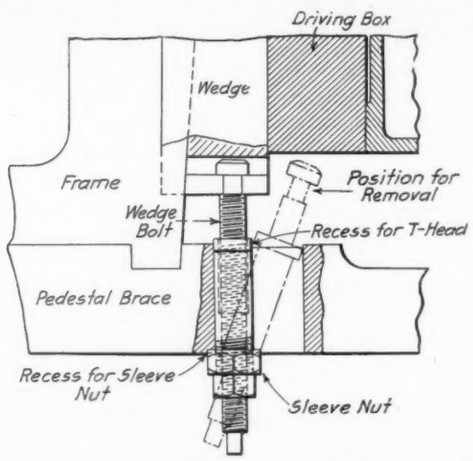
Packing Guard for Journal Boxes

journal box. In applying the guard the weight of the car is raised from the journal and the box packed, the packing being pushed well back against the dustguard and the box filled only to the end of the journal. The guard is then placed in the box with the tongue, which is formed to fit the lugs at the top of the box, between the box and the wedge. When in position the weight of the car is let down on the journal, thus securely holding the guard in place. A small quantity of packing is then pushed around the sides of the guard. Holes are provided in the packing guard through which oil may be applied should the packing become dry. The guard is manufactured in different sizes and to fit the various types of journal boxes.

LOCOMOTIVE WEDGE BOLT

The wedge bolt shown in the drawing is designed to be applied and removed without the necessity of taking down the pedestal binder. The device, which is manufactured by the Wine Railway Appliance Company, Toledo, Ohio, is made standard for all wedges on the locomotive, and in case of emergency may be renewed by the engineer while the engine is in service on the road.

The pedestal brace is provided with a slot, as shown in the drawing, through which is inserted a tee headed sleeve. The wedge bolt is screwed into this sleeve, which in its normal position becomes a rigid part of the brace, and the bolt is operated in the same manner as if the sleeve were not used. The top of the pedestal brace is provided with a recess for the reception of



Wedge Bolt Removable While the Locomotive is in Service

the tee head and the bottom of the brace is provided with a recess for the reception of the sleeve nut, which is threaded on the sleeve. The wedge bolt is thus held rigidly within the pedestal brace.

It will be noted that the nut which locks the wedge bolt bears against the sleeve nut and acts as a lock nut for the sleeve as well.

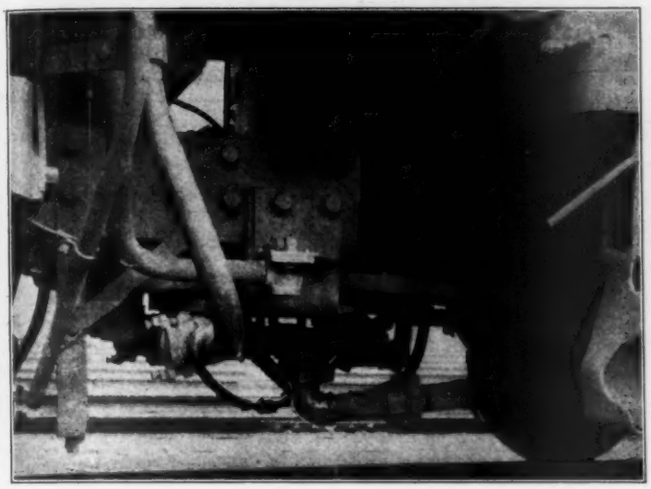
To remove one of these bolts, all that is necessary is to back off the lock and sleeve nuts until the tee head on the sleeve can be lifted out of the recess on the top of the pedestal brace. The sleeve is then revolved through 90 deg. into the position shown by dotted lines, the head of the wedge bolt being slid out of the slot in the wedge at the same time. In order to do this the wedge must be drawn down into the position shown so that the slot in the wedge is clear beneath the driving box.

This device is in use on about 100 engines and is said to be giving excellent service.

EXPORT OF FORD MOTOR CARS.—The Ford Motor Company, Detroit, Mich., announces an order for 40,000 motor cars for shipment to one of the allied nations. It is the largest recorded single order for motor cars, and is said to involve $16,000,000 to $18,000,000.—*Iron Age.*

SINGLE LOCOMOTIVE WATER JOINT

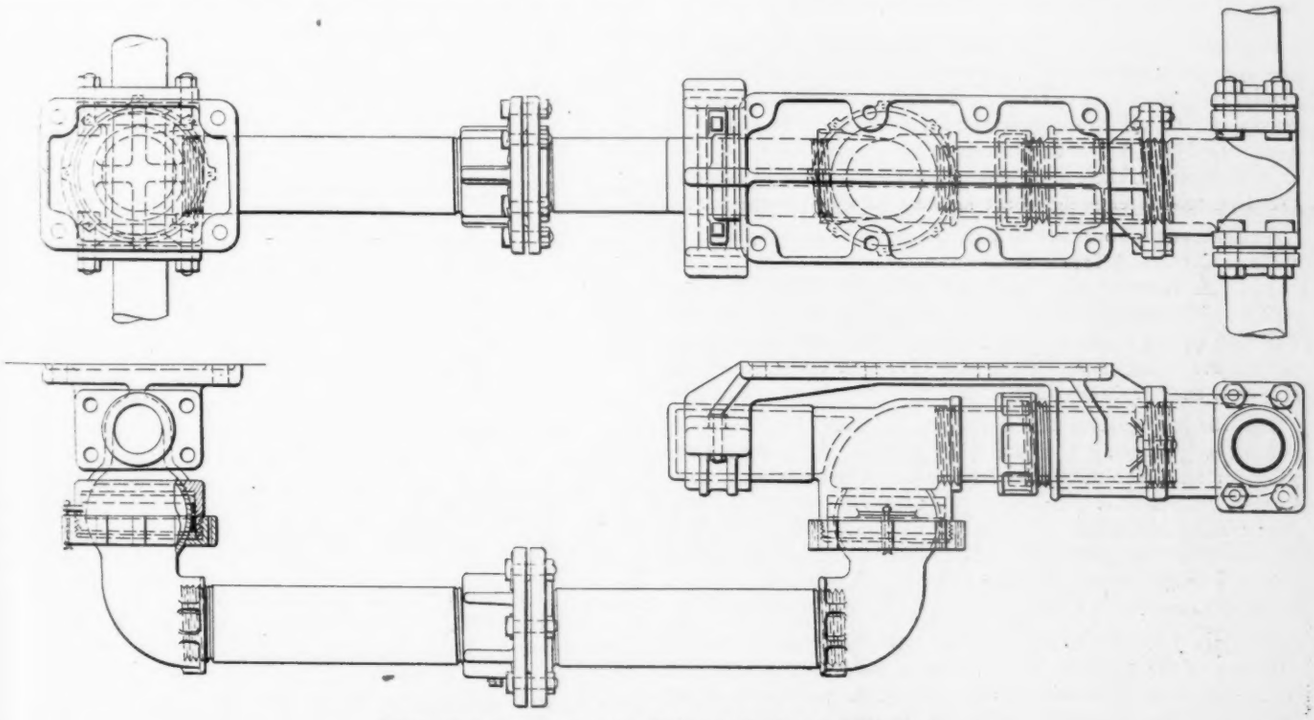
The single water joint illustrated below has recently been developed by the Franklin Railway Supply Co., 30 Church street, New York. It eliminates the use of the present rubber hose connections for the injector suction pipes and provides one connection which is large enough to supply water to both injectors. It is located directly under the drawbar on the center line of the locomotive.



Location of the Single Water Joint Under the Drawbar

The water connection, which is made up of extra heavy wrought iron pipe, is attached at either end to tee heads, the branches of which lead to the two tank wells on the tender and to the two injector suction pipes on the engine. It includes two ball joints and one slip joint, a combination which takes any motion occurring between the engine and tender. At its rear end the inside sleeve of the slip joint is threaded into an elbow connection which turns downward and forms the outer casing of the forward ball joint. An extension is cast on the elbow which is supported in a slide bearing bracket secured to the deck of the locomotive. This arrangement serves as a guide for the slip joint, relieving it from lateral strain.

All the attention this joint is said to require is the occasional renewal of the gasket in the ball and slip joints. One of the difficulties it is expected to overcome is freezing, which often occurs in the present hose connections. The probability of freezing in this connection is reduced owing to the fact that either heater will keep it open while both heaters are required with the usual type of double connection.



Single Water Joint for Use Between Engine and Tender

INDIAN WATER POWER SYSTEM.—On February 10 the governor of Bombay opened the Tata hydro-electric scheme, which ultimately will provide Bombay with electric energy equal to 130,000 hp., or five times the amount hitherto derived from water throughout India.—*The Engineer.*

CONVERTING BRITISH CARS.—Since 1911 the many passenger vehicles which have been added to the Great Eastern Railway Company's stock have all been mounted on two four-wheeled trucks, and no further carriages will be built to older designs. Many of the more modern of the non-bogie type, however, still possess substantial life, and a plan is being followed to convert these into bogie or four-wheel truck cars. The bodies of these vehicles are 27 ft. in length and, as the standard bogie underframe is 54 ft. long, two of them are placed together on one frame. One end of both bodies is stripped of panels and moldings and the overhanging roof boards are cut off level with the framework. The bodies are then placed on the underframe and butted and bolted together through the framework. The side joints are covered with a facia molding and the roof joint is filled in and covered with raw canvas bedded in stiff paint. The combined bodies are secured to the underframe with body bolts in the ordinary way, whilst the usual stop blocks are placed at each end. It is rarely that a body has to be lifted from the underframe; but in case of such necessity the body would be divided where joined and lifted in two sections. Although this policy results in a decreased number of vehicles, the seating capacity is not diminished, and it is probable that some 500 carriages will be treated in this way.—*The Engineer.*

NEWS DEPARTMENT

On March 4 the roundhouse of the Cleveland, Cincinnati, Chicago & St. Louis at Benton Harbor, Mich., was destroyed by fire.

It is reported that the International & Great Northern is planning to completely electrify its shops at Palestine, Tex., at an approximate cost of $25,000.

The Queen & Crescent Route has recently completed a new coach shop building at Chattanooga, Tenn., which will accommodate most of the coach repair work of the road. The building is 300 ft. by 106 ft., and was built by the road's own forces.

John G. Cooper, of Youngstown, Ohio, until lately a locomotive engineer on the lines of the Pennsylvania company, is now the representative in Congress from the Nineteenth Ohio district. He has served two terms in the Ohio legislature and has been a prominent worker in the anti-liquor campaign.

The "Safety First" committee of the Baltimore & Ohio reports that 91 per cent of all items recommended to improve safety conditions during 1914 were disposed of by the company. Recommendations totaling 9,256 items were made by 698 employees, who are members of safety committees on 23 divisions. Only 806 of the items reported remain under consideration.

J. E. Long, safety engineer of the Canadian Government Railways—the Intercolonial and the Prince Edward Island—reports that during the first year of his incumbency, January 1, 1914, to January 1, 1915, fatal injuries to employees have fallen off from 19, in 1913, to 7, in 1914; injuries have been reduced from 695 to 523, and the number of trespassers killed dropped from 22 to 13.

Aiming to protect its employees against permanent injury to the eye, the Baltimore & Ohio urges, in a circular issued recently, that in case of eye injury, or of foreign particles lodging in the eye, to secure the service of a company physician whenever possible. Railroad experience cites many cases of permanent injury to the eye or loss of sight as a result of inexperienced persons attempting to act in the capacity of surgeons.

The Canadian government, confronted with the continued refusal of the Grand Trunk Pacific to operate the National Transcontinental Railway, which extends 1,500 miles from Moncton, N. B., to Winnipeg, Man., announces that to prevent the destruction of the road bed and track by floods and frost, preparations are being made to organize forces to take care of the property, and, probably, to establish a regular train service.

The Russian government is negotiating with the New York Air Brake Company and the Westinghouse Air Brake Company for an order of 2,000,000 shrapnel. The Russian government has already established a credit in this country to meet payment for one-fourth of the order, which, it is said, will have a total value of $36,000,000. The same government recently placed a large order for shrapnel with the Canadian Car & Foundry Company.

Governor Johnson of California has started a movement for the purchase of the Western Pacific, now in the hands of receivers, by the state of California. The governor is quoted as saying, "It is my idea that with California owning and operating a great transcontinental railroad the state will always be assured of commercial freedom." A memorial to Congress requesting it to take action toward the purchase of the road by the federal government has been introduced in both the House and Senate of the California legislature.

The Southern Railway has just put in service 57 steel passenger cars, all electric-lighted. These cars have been assigned to eight of the most important through trains; and steel-frame cars heretofore used on these trains have been assigned to other through trains. This in turn has released steel underframe cars for use in local trains. Seven steel dining cars have recently been put in service.

Rule G, the well-known paragraph of the Standard Code of Train Rules prohibiting the use of intoxicating liquors, has been taken as the theme for a motion picture, based on Rufus Steele's story in the Saturday Evening Post. The film was staged in the yards and offices of the Southern Pacific Company at San Francisco, and the road placed all its facilities at the disposal of the camera men. Even the actors were selected from the ranks of the company's employees. This film is to be shown in numerous places along the Southern Pacific lines, and elsewhere.

The testing laboratory of the New York, New Haven & Hartford at New Haven, Conn., during the past year has made about 10,000 tests, the articles tested ranging all the way from pencils to piston rods and from milk to paint. Special attention has been given to sanitation on passenger trains, and the milk and cream for the dining cars have been kept at the highest standard. The physicists of the laboratory have made a large number of tests of air in passenger cars on trains, and a thorough system of sterilizing drinking water receptacles on trains has been established. The chemists have analyzed the water from each one of the wells on the company's premises.

Peter M. Hoffman, coroner of Cook county, Illinois, has addressed a circular letter to various clubs and organizations in the county giving statistics of railroad accidents and pointing out the large preponderance of accidents to trespassers on railroad property. He encloses a copy of a bill which is before the Illinois legislature to prohibit trespassing and urges efforts on the part of the organizations to secure its passage. He shows that in 1914 there were 282 people killed in Cook county by railroads or on railroad tracks. Of these 13 were passengers, 100 were employees and 169 were trespassers. For the 10 years, 1905 to 1914, his records show that 80 passengers, 1,399 employees and 1,922 trespassers were killed.

The Pennsylvania Railroad reports that 427 fires—more than three-quarters of all that occurred on the property of the system last year—were extinguished by company employees before receiving the aid of public fire departments. The average loss was $43. Organized fire brigades among the employees last year checked 34 fires, and other employees, by the use of chemical extinguishers, put out 71. The total fire loss on the Pennsylvania system during the year 1914, including fires where the assistance of city fire departments was received, was $658,483, while the value of the entire property was nearly $400,000,000, the fire loss being only 16 cents per each $100 of property value at risk.

The safety department of the Delaware, Lackawanna & Western has issued Safety First Bulletin No. 10, giving a summary of accidents to Lackawanna employees for the years 1911, 1912, 1913 and 1914. The number of employees killed in 1911 was 70, and in 1912, 46; 1913, 45, and in 1914, only 26. The number of employees injured in 1911 was 2,319; in 1912, 2,318; in 1913, 2,092, and in 1914, 1,875. There has thus been a steady decrease year by year. Comparing 1914 with 1911, the decrease in the number of employees killed was 63 per cent, while the injured decreased 19 per cent. It has been decided to award a Safety First flag to the division making the best safety record in 1914, and subsequent years, and also one to the shop making the best record. For the year 1914, the Morris & Essex division was

awarded the division flag and the Scranton-Keyser Valley shops were awarded the shop flag.

Congress, in making appropriations for the support of the army for the next fiscal year, has inserted in the law a proviso that no part of the appropriations made at this time shall be available "for the salary or pay of any officer, manager, superintendent, foreman or other person having charge of the work of any employee of the United States government while making or causing to be made, with a stop watch or other time-measuring device, a time study of any job of any such employee between the starting and completion thereof, or of the movements of any such employee while engaged upon such work; nor shall any part of the appropriations made in this bill be available to pay any premium or bonus or cash reward to any employee in addition to his regular wages, except for suggestions resulting in improvements or economy in the operation of any government plant; and no claim for services performed by any person while violating this proviso shall be allowed."

One of the striking exhibits at the Panama-Pacific Exposition is that of the Westinghouse Electric & Mfg. Company, which includes one of the Pennsylvania electric locomotives mounted on a turntable. The location of the turntable is under the center of the dome of the Transportation building at the junction of the two main aisles, thus bringing it in full view of the crowds which are expected to pass through this building. The turntable is 65 feet long, and, including the locomotive, weighs 440,000 pounds. The height of the track is 12 ft. above the floor, and steel ties are used, a new type of construction for this class of work. By means of a 10-horsepower motor the turntable is caused to rotate at a speed of one revolution in three minutes. The rotation, which can be reversed in direction, is under the control of the operator located in a booth nearby. The locomotive is arranged and lighted so as to permit the people to pass through it and inspect the equipment.

Commissioner Mayfield of the Texas Railroad Commission has sent a telegram to J. W. Everman, general superintendent of the St. Louis Southwestern of Texas, protesting against the recent closing of the company's shops at Tyler, Tex., which threw out of employment some 300 or 400 men. The commissioner says in his telegram that the company's business is better than it has been for some time, requiring, as he is advised, "an extra switch engine to adequately handle the traffic," and that the road should be getting its equipment in condition to handle the large business expected this spring and summer. He says that unless the shops at Tyler are reopened and the men put back to work he will consider it his duty to move that the commission suspend further action on the application for an increase in freight rates pending investigation into the reason why the shops were closed. Mr. Everman said it was found absolutely necessary to close the shops at Tyler because of the decrease in earnings.

M. A. Dow, general safety agent of the New York Central Lines, is sending out to manufacturers owning plants adjacent to the company's property small printed slips on "safety first," to be put into the pay envelopes of employees. The statement begins by saying that the railroad company has called the manufacturers' attention to the risk incurred by the employees of the factory who walk on the tracks; and, after briefly explaining the general situation, it ends with the injunction that "the practice of walking the railroad tracks by our employees must be stopped at once. The interests of personal safety require that strict observance of this rule must be enforced." Mr. Dow furnishes the slips printed in English and other languages, as may be needed. Within a reasonable time after the notices have been supplied to a given factory, the inspectors of the railroad company make observations to see how well the advice has been carried out; and if track walking continues officers are sent to make some arrests.

NEW RAILROAD LAWS IN TEXAS

The legislature of Texas has concluded its session of two months and a final review shows that it has passed only a few general laws affecting railroads. The most important, perhaps, is that requiring employees to be paid twice a month. Another one provides that employees of railroads (and of certain other concerns as well) shall be free to choose the company from which they shall get surety bonds. The railroads now provide bonds without cost to the employee.

The railroad commission is authorized, by one of the new laws, to require railroads to make track connections with industries.

There was a full-crew law, but it died on the calendar as did the bill to require sheds to be built at all points where there are ten or more car repairers at work.

On the whole it appears to many careful observers that the anti-railroad spirit among the Texas law makers is very much abated.

MEETINGS AND CONVENTIONS

Chief Interchange Car Inspectors' and Car Foremen's Association.—At a recent meeting of the executive committee of the Chief Interchange Car Inspectors' and Car Foremen's Association, which was held in Chicago, it was decided to hold the next annual convention of the association in Richmond, Va., September 14, 15 and 16.

Air Brake Association.—The twenty-second annual convention of the Air Brake Association will be held at the Hotel Sherman, Chicago, on May 4-7, 1915. The following is a list of the subjects to be discussed at the meeting: Accumulation of Moisture and Its Elimination From Trains and Yard Testing Plants; Adequate Hand Brakes on Heavy Passenger Equipment Cars; Need of Efficient Cleaning and Repairing of Freight Brakes; What Shall We Do to Improve the Present Pneumatic Signal Device; Difficulties the Railroad Companies Encounter in Endeavoring to Run 100 Per Cent Operative Brakes in Freight Train Service; M. C. B. Air Brake Hose Specification and Recommended Practice. The afternoon of May 6 has been set aside for a series of air brake lectures, delivered by representatives of the Pittsburgh Air Brake Company, Westinghouse Air

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	April 13	Systematic Locomotive Valve Setting	J. R. Britton	James Powell	St. Lambert, Que.
Central	May 9			Harry D. Vought.	95 Liberty St., New York.
New England	April 13	Economical Handling of Freight Cars	W. C. Kendall	Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	April 16	Recent Developments in Locomotives	George R. Henderson	Harry D. Vought.	95 Liberty St., New York.
Pittsburgh	April 23			J. B. Anderson	207 Penn Station, Pittsburgh, Pa.
Richmond	April 12	Chilled Iron vs. Steel Wheels	F. K. Vial	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	April 9	Encouraging Railroad Men to Buy Homes.	H. M. Cottrell	B. W. Frauenthal.	Union Station, St. Louis, Mo.
South'n & S'w'rn.	May 20			A. J. Merrill	Box 1205, Atlanta, Ga.
Western	April 20			Jos. W. Taylor	1112 Karpen Bldg., Chicago, Ill.
Western Canada				Louis Kon	Box 1707, Winnipeg, Man.

Brake Company, New York Air Brake Company, and possibly the Automatic Straight Air System, each speaker being limited to one hour. The practice inaugurated at the last convention of giving one afternoon to the representatives of the manufacturers for the exploitation of their devices will again be followed this year, and May 4 is the date which has been assigned for the purpose.

Master Car and Locomotive Painters' Association.—The Advisory Committee of the Master Car and Locomotive Painters' Association has selected the following subjects and queries to be considered at the next convention, which will be held at Detroit, Mich., September 14 to 16: Subject No. 1, Flat color v. enamel color—which gives the best results under varnish in durability and permanency of color? No. 2, Can we suggest any changes in the design or construction of steel passenger train cars to make them better fitted for preservation by protective coatings? No. 3, Will equipment finished in enamel or varnish color wear and "clean up" in service as easily and economically as the varnish finish? No. 4, Best methods of taking care of piece-work accounts, including rate fixing, printed forms, clerical organization, etc., for work in paint shops. No. 5, What is the most practical and economical method of maintaining the inside of steel passenger cars? Essay No. 1: The possible results, where price vs. quality is enforced in buying paint stock for the railway car and locomotive paint shop. No. 2: The official recognition due to the efficient railway master car and locomotive painter. Query No. 1: Are we having any serious trouble with varnish turning white and if so, with what grade of varnish? No. 2: Is there any way by which a greater field of the work of the association can be covered, without increasing the time consumed in handling the work? No. 3: Of what value to the railway companies is ornamentation to the exterior of railway passenger equipment?

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 4-7, 1915, Hotel Sherman, Chicago.

American Railroad Master Tinners, Coppersmiths and Pipefitters' Association.—W. E. Jones, C. & N. W., 3814 Fulton street, Chicago. Annual meeting, July 13-16, 1915, Hotel Sherman, Chicago.

American Railway Master Mechanics' Association.—J. W. Taylor, Karpen building, Chicago. Convention, June 9-11, 1915, Atlantic City, N. J.

American Railway Tool Foremen's Association.—Owen D. Kinsey, Illinois Central, Chicago. Convention, July 19-21, 1915, Hotel Sherman, Chicago.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Convention, June 22-26, 1915, Hotel Traymore, Atlantic City, N. J.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth street, New York. Annual meeting, December 7-10, 1915, New York.

Association of Railway Electrical Engineers.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Sta., Chicago. Annual meeting, October, 1915.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, except July and August, Lytton building, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio. Annual meeting, September 14-16, 1915, Richmond, Va.

International Railway Fuel Association.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 17-20, 1915, Chicago.

International Railway General Foremen's Association.—William Hall, 1126 W. Broadway, Winona, Minn. Convention, July 13-16, 1915, Hotel Sherman, Chicago.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio. Convention, August 17, 1915, Philadelphia, Pa.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty street, New York. Convention, May 26-28, 1915, Chicago, Ill.

Master Car Builders' Association.—J. W. Taylor, Karpen building, Chicago. Convention, June 14-16, 1915, Atlantic City, N. J.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass. Convention, September 14-17, 1915, Detroit, Mich.

Niagara Frontier Car Men's Association.—E. Frankenberger, 623 Brisbane building, Buffalo, N. Y. Meetings monthly.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention, May 17-19, 1915, Hotel Sherman, Chicago.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, September, 1915, Chicago, Ill.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

G. P. Goodrich, who has been master mechanic of the Fort Smith & Western and the St. Louis, El Reno & Western for the last eight years, has resigned, effective April 1.

J. W. Johnson has been appointed master mechanic of the Arkansas, Louisiana & Gulf, with office at Monroe, La., succeeding J. T. Tadlock.

A. E. McMillan, whose appointment as master mechanic of the Baltimore & Ohio Southwestern, at Washington, Ind., was announced in these columns last month, was born in Wheeling, W. Va., December 26, 1880. He received his education in the public schools of that city, graduating from the high school in 1898. Early in 1899 he entered the service of the Baltimore & Ohio at Benwood, W. Va., as a machinist apprentice, and on completing his apprenticeship he served as a machinist at the same point. In 1905 he was made machine shop foreman, serving in this capacity and as drop pit foreman until September, 1907. He was then appointed engine house foreman, and in April, 1910, became general foreman at Benwood. Early in 1913 he was transferred to the Baltimore & Ohio Southwestern system as motive power inspector, with headquarters at Cincinnati, Ohio, and a year later was appointed assistant master mechanic, in which capacity he served until his recent appointment as master mechanic.

R. J. McQuade has been appointed master mechanic of the St. Louis & Kansas City Terminal division of the Rock Island Lines, with office at Armourdale, Kan., succeeding O. C. Breisch, resigned.

A. Young, whose appointment as district master mechanic of the Chicago, Milwaukee & St. Paul, at Milwaukee, Wis., was announced in these columns last month, was born January 24, 1874. After graduating from the public schools in Milwaukee he was employed in the foundry of the Chicago, Milwaukee & St. Paul for one year, and then transferred to the machine shop as a machinist apprentice. After completing his apprenticeship, Mr. Young remained in the employ of the St. Paul, serving as a machinist at various points until 1898, when he left the service to become an engineer in the Milwaukee city fire department. In the spring of 1902 he left the fire department to again enter the St. Paul service as a machinist in the Milwaukee shops, where he remained until 1905. He was then transferred to the roundhouse at the West Milwaukee shops, where he served successively as slip foreman, assistant foreman and general roundhouse fore-

A. Young

man, being promoted to the latter position in 1909. In July, 1913, Mr. Young was transferred to Chicago as general foreman at that point, in which capacity he served until his recent appointment as district master mechanic. Mr. Young is a graduate of the International Correspondence School.

W. L. SCOTT has been appointed master mechanic of the Missouri, Kansas & Texas at Denison, Tex., succeeding N. S. Airhart, resigned.

CAR DEPARTMENT

A. COPONY, master car builder of the western lines of the Grand Trunk, has had his office moved from Port Huron, Mich., to Elsdon, Ill.

V. J. LAMB, car foreman of the Charleston & Western Carolina, at Augusta, Ga., has been appointed general foreman car repairs at that place, succeeding W. F. Weigman.

T. W. MARSHALL has been appointed assistant car foreman of the Canadian Pacific at Transcona, Man., succeeding H. Dibley.

SHOP AND ENGINE HOUSE

A. BEARDSHAW has been appointed locomotive foreman of the Grand Trunk at Richmond, Que., succeeding G. Blackbird, retired on a pension.

W. C. BUREL, district foreman of the Oregon Short Line at Montpelier, Idaho, has been appointed general foreman of the Utah district, Utah-Montana division, at Salt Lake City, Utah, succeeding H. Selfridge.

R. A. MILLER has been appointed general foreman of the Canadian Northern at Trenton, Ont., succeeding W. G. Rodden.

W. R. PATTERSON has been appointed general foreman of shops of the Michigan Central at Detroit, Mich., succeeding A. K. Galloway.

D. ROSS, formerly locomotive foreman at the Southwark Terminal of the Grand Trunk at Montreal, has been appointed locomotive foreman at Durand, Mich.

C. E. STEWART has been appointed locomotive foreman of the Grand Trunk Pacific at Edmonton, Alta.

CHARLES D. WILDER has been appointed boiler foreman of the Staten Island lines of the Baltimore & Ohio, at Clifton, Staten Island.

JOHN E. WOODS has been appointed general foreman of the Staten Island lines of the Baltimore & Ohio, at Clifton, Staten Island.

R. R. YOUNG has been appointed general foreman of the shops of the Tennessee Central at Nashville, Tenn.

PURCHASING AND STOREKEEPING

FRANK DUNBAR has been appointed storekeeper of the Intercolonial at Gibson, N. B.

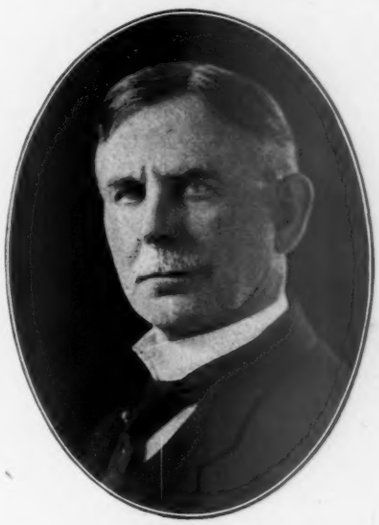
JOHN O'BRIEN has been appointed storekeeper of the Canadian Pacific at Regina, Sask.

OBITUARY

CHARLES MCCANN, general foreman of the Chicago Junction Railway, died in Chicago, March 6, at the age of 65 years. Mr. McCann began railway work on the Atlantic & Great Western at Kent, Ohio, in 1867. He was later employed by the Lake Shore & Michigan Southern at Norwalk, Ohio, and the New York, Chicago & St. Louis, during the construction of this road between Conneaut, Ohio, and Ft. Wayne, Ind. In 1897 he left the latter road to enter the service of the Chicago Junction Railway, with which he remained until his death.

JOHN W. ADDIS, formerly superintendent of motive power of the Texas & Pacific, died at Marshall, Tex., on February 25. He was born on March 13, 1851, at East Liberty, Pa., and after learning the trade of machinist entered the shops of the International & Great Northern, at Palestine, Tex. In 1882 he went to the Marshall shops of the Texas & Pacific, and left that road to become general foreman at the Tyler shops of the St. Louis Southwestern. He was transferred later to the Pine Bluff shops, of which he had charge, and was then for about four years master mechanic at the Gouldsboro shops of the Texas & Pacific. About 1892 Mr. Addis succeeded A. G. Douglass as superintendent of motive power and rolling stock of the Texas & Pacific at Marshall, and remained in the service of that road until June, 1911.

WILLIAM MCINTOSH, formerly superintendent of motive power of the Central of New Jersey, at Jersey City, N. J., died on March 15, at his home in Plainfield, N. J. He was born on August 20, 1849, at Franklin, Que., and began railway work in 1864 as a locomotive fireman on the Chicago, Milwaukee & St. Paul; and he served as machinist and engineer on that road for seven years. In 1871 he went to the St. Paul & Pacific, now a part of the Great Northern, at St. Paul, Minn., where he was employed as machinist. From August, 1872, to November, 1877, he was locomotive engineer on the Chicago & North Western and then for about ten years was foreman of locomotive repairs on the same road at Waseca, Minn., and at Huron, S. D. In July, 1887, he was appointed master mechanic at Winona, Minn., where he remained about 12 years. On March 1, 1899, he was appointed superintendent of motive power of the Central of New Jersey, from which position he retired in 1909. He was a prominent member of the American Railway Master Mechanics' Association, and in 1908 served as president of that association. Mr. McIntosh was the inventor of a number of well known locomotive and car appliances. He was a member of the American Society of Mechanical Engineers.



W. McIntosh

EXHAUST STEAM INJECTORS FOR LOCOMOTIVES.—The exhaust steam injector has found quite extensive use on British locomotives, and from what information can be obtained it is believed to be one of the small economy producers that are worthy of consideration. From its extended use it can no longer be considered experimental. The exhaust steam is taken from the exhaust pipe just above the outlet from the cylinders. It then passes through a separator which removes all the grease and particles of dirt, and then goes direct to the injector. Live steam is used to start the injector. This may be entirely shut off after the exhaust steam has been started, or a small amount can be admitted to assist in pumping against a high boiler pressure. When the engine is not working provision is made for operating the injector by live steam alone. From tests made in England it is found that an average saving of 700 to 1,000 lb. of coal and about 4,000 lb. of water per 100 miles is obtained. For boiler pressures in the neighborhood of 200 lb. it is necessary to supplement by the use of a small amount of live steam, the exhaust steam at atmospheric pressure being capable of delivering against 120 lb. boiler pressure.

SUPPLY TRADE NOTES

Frederick A. Hall, formerly head of the chain hoist department of the Yale & Towne Company, died at his home in Passaic, N. J., on March 16.

J. W. Fogg, formerly master mechanic of the Baltimore & Ohio Chicago terminal, has become associated with the Boss Nut Company, with headquarters at Chicago.

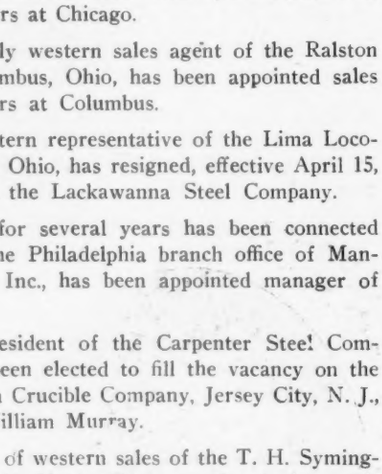
A. D. McAdam, formerly western sales agent of the Ralston Steel Car Company, Columbus, Ohio, has been appointed sales manager, with headquarters at Columbus.

G. Haven Peabody, western representative of the Lima Locomotive Corporation, Lima, Ohio, has resigned, effective April 15, to accept a position with the Lackawanna Steel Company.

W. C. Chapman, who for several years has been connected with the sales force of the Philadelphia branch office of Manning, Maxwell & Moore, Inc., has been appointed manager of that office.

Robert E. Jennings, president of the Carpenter Steel Company, Reading, Pa., has been elected to fill the vacancy on the board of the Joseph Dixon Crucible Company, Jersey City, N. J., caused by the death of William Murray.

W. W. Rosser, manager of western sales of the T. H. Symington Company, Rochester, N. Y., has been appointed vice-president of the company, with office at Chicago. Mr. Rosser was born at Hutchinson, Minn., on November 4, 1877. He attended the Hamline University at St. Paul, Minn., and was for four years with the Minnesota Malleable Iron Company. In 1903 he left the company to take the position of superintendent of the Washburn Coupler Company, and two years later became sales agent of the T. H. Symington Company at Chicago. In 1910 he was appointed manager of western sales of that company, and now leaves that position to take up the duties of vice-president, as above noted.



W. W. Rosser

E. L. Leeds, who since 1907 has been manager of the railroad equipment department of the Niles-Bement-Pond Company, New York, has been appointed general manager of sales of that company and the Pratt & Whitney Company, Hartford, Conn.

The Superior Car Metal Roofing Company, Chicago, Ill., has recently been incorporated for $25,000 for the purpose of manufacturing and selling car roofs, doors, locks, etc. The incorporators are William H. Slatten, William F. Nolan and E. A. Albright.

The Stark Rolling Mill Company, Canton, Ohio, has appointed the Dearborn Steel & Iron Company, with offices in the Peoples Gas building, Chicago, Ill., as its selling agent in Chicago, northern Illinois and Wisconsin. H. C. Perrine and E. L. Lyon will represent the company.

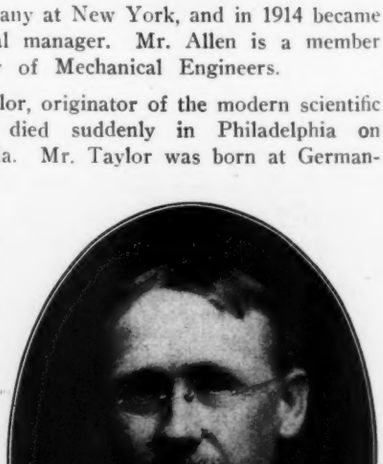
The Sprague Electric Works of the General Electric Company, New York, has opened a branch sales office in the Illuminating building, Cleveland, Ohio, and Frank H. Hill, who also has charge of the Pittsburgh office, has been appointed manager of the Cleveland office.

The Locomotive Pulverized Fuel Company has obtained a charter in Delaware to manufacture patented fuel saving devices. The incorporators are Joel S. Coffin, Englewood, N. J.; John E. Muhlfeld, Scarsdale, N. Y.; H. F. Ball and Samuel G. Allen, New York, and LeGrand Parish, Mountain View, N. J.

Walter C. Allen, vice-president and general manager of the Yale & Towne Manufacturing Company has been elected president and general manager to succeed Henry R. Towne, who has been elected chairman of the board. Mr. Allen has been in the service of the company for 23 years. He entered the works in 1892 as a truck boy and two years later obtained a position in the office. He then spent three years acquiring the tool trade, and three more to obtain a knowledge of drafting, both of which he thought were essential to his advancement with the company. He was later made assistant to the general superintendent in the works at Stamford, and then became general superintendent. In 1909 he was appointed general manager of the company at New York, and in 1914 became vice-president and general manager. Mr. Allen is a member of the American Society of Mechanical Engineers.

W. C. Allen

Frederick Winslow Taylor, originator of the modern scientific management movement, died suddenly in Philadelphia on March 21 from pneumonia. Mr. Taylor was born at Germantown, Pa., on March 20, 1856. He attended Phillips Exeter Academy, but left before completing the course, because of impaired eyesight. In 1883, however, he graduated from Stevens Institute of Technology with the degree of Mechanical Engineer. In 1878 he entered the employ of the Midvale Steel Company, with which company he was successively gang boss, assistant foreman, foreman of the machine shop, master mechanic, chief draftsman and chief engineer. He left the company in 1889 and began his special work of reorganizing the management of manufacturing establishments. Mr. Taylor was an inventor of considerable ability. Among his numerous inventions was the Taylor-White process of treating modern high-speed tools, for which he received a personal gold medal from the Paris Exposition in 1900 and the Elliott Cresson medal of the Franklin Institute. Mr. Taylor was a member of the American Society of Mechanical Engineers, and



F. W. Taylor

served as its president in 1905 and 1906. He was the author of a number of technical books and articles, among the best known being "The Principles of Scientific Management" and "Shop Management," both published in 1911.

Henry H. Sessions, vice-president of the Standard Coupler Company of New York, died at his residence in Chicago, on March 14. Mr. Sessions was born in Madrid, N. Y., on June 21, 1847. He entered railway service on March 1, 1862, and until January 1, 1870, he served as apprentice and journeyman in the car and machine shops of the Central Vermont at Northfield, Vt. From January 1, 1870, to November 1, 1878, he was master car builder of the Rome, Watertown & Ogdensburg, and from then to April 1, 1880, for the Sioux City & St. Paul, now a part of the Omaha. On April 1, 1880, he was made master car builder of the International & Great Northern, and on May 10, 1881, and September 1, 1882, he was appointed to similar positions with the Texas & Pacific and the St. Louis, Iron Mountain & Southern, respectively. In 1885 he was made manager of the Pullman Car Works. This position he held until 1892, and for four years he was chief mechanical engineer in an advisory capacity for the same company. During this time he invented the passenger car vestibule, and later designed the standard steel platform for passenger cars which went into general use at once. This led to his becoming associated with the Standard Coupler Company as vice-president and director in 1896. Mr. Sessions also designed the Sessions friction draft gear and in the course of his active life left a strong impression of his inventive genius on railroad operations in many ways.

H. H. Sessions

On March 22 the Chicago office of the Terry Steam Turbine Company, Hartford, Conn., was placed in charge of A. W. de Revere, and located in the Peoples Gas building. The company has also opened an office in the Michigan Trust building, Grand Rapids, Mich., in charge of A. L. Searles, who will cover the southern peninsula of Michigan.

Joseph Mohr, president of John Mohr & Sons, boiler manufacturers of Chicago, Ill., died at his home on March 2, 1915. Mr. Mohr was born in Chicago in 1855, and, after serving an apprenticeship as boilermaker, he engaged in business with his father in 1882, under the firm name of John Mohr & Son, which was later changed to John Mohr & Sons.

The Southwark Foundry & Machine Company, Philadelphia, Pa., has secured the exclusive United States license to manufacture the Harris Valveless Engine, Diesel principle, which will hereafter be known as the Southwark-Harris Valveless Engine. The engine will be built in sizes from 75 B. H. P. to 1,000 B. H. P., for both marine and stationary service. With the company there will be associated as consulting engineer and naval architect Leonard B. Harris, the inventor of the Harris valveless engine, so that the company will have the benefit of his extensive experience in power engineering, especially in the marine field. J. P. Johnston, who has been interested in and connected with the Harris valveless engine, will also be associated with the company in charge of oil engine sales. The Southwark Foundry & Machine Company also manufactures a full line of steam turbines, generators, turbine pumps, hydraulic pumps and presses, condensers, etc.

Two suits by the Safety Car Heating & Lighting Company, New York, against the United States Light & Heating Company, Niagara Falls, N. Y., have recently been decided in favor of the defendant by Judge Hazel in the Western District of New York. These suits were on the W. I. Thompson Patent No. 881,743, March 10, 1908, on a dynamo suspension for car lighting, and W. I. Thompson Patent No. 926,518, June 29, 1909, on a lighting system commonly referred to as the carbon disk regulator. In each case the patent was held invalid and the bill of complaint dismissed. The court held that the predecessors of the United States Light & Heating Company had installed dynamo suspensions and the carbon disk regulator substantially as described and claimed in the patents, on their own apparatus on the New York Central prior to the dates of the patents.

Henry R. Towne, president of the Yale & Towne Manufacturing Company, New York, for 46 years, having signified his desire to retire from the duties of that office, has been elected chairman of the board. Mr. Towne was born in Philadelphia, Pa., August 28, 1844. He attended the University of Pennsylvania, but he left before graduation to enter business, receiving, however, the honorary degree of M. A., in 1887. He was first employed as a mechanical draftsman in the Port Richmond Iron Works at Philadelphia. In 1866 he made an extensive tour of the leading engineering establishments in England, Belgium and France, spending six months in Paris, where he studied at the Sorbonne. Upon his return he worked for some time in the shops of William Sellers & Co., Philadelphia. In October, 1868, he formed a partnership with Linus Yale, Jr., and the Yale Lock Manufacturing Company was established at Stamford, Conn. Mr. Yale died shortly after, and in 1869 Mr. Towne became the president of the company, which at that time had a factory with 30 employees at Stamford and a salesroom in New York. To sketch Mr. Towne's career from that time is to sketch the growth of his company. At first it made bank locks and the Yale pin-tumbler locks. Later there were added safe deposit locks, mortise locks, the Yale time lock, etc. The company also had an important business in complete post office "equipments." In 1873 it added a bronze department, and in 1882 it established an art department. The company secured the American rights for the Weston differential pulley block. It was also one of the first, if not the first, in America, to build cranes, but the crane business was later sold to the Brown Hoisting Machinery Company, Cleveland, Ohio. It being felt that the name Yale Lock Manufacturing Company was not sufficiently inclusive, the title was changed in 1883 to the Yale & Towne Manufacturing Company. The company took many steps to broaden its activities. In 1878 it absorbed the United States Lock Company and the American Lock Company; in 1894 the Branford Lock Works, and in 1895 the Blount Manufacturing Company, in each case adding new lines. Mr. Towne has been an active member of the American Society of Mechanical Engineers for many years and served as its president.

Henry R. Towne

CATALOGS

ELECTRIC DRILLS.—Bulletin E-35 has recently been issued by the Chicago Pneumatic Tool Company. It is devoted to electric portable drills which are designed for operation on direct or alternating current.

PREVENTION OF BELT SLIPPING.—The Gripwell Pulley Covering Company, 601 Candler building, New York, has just issued a folder devoted to its product "Gripwell," which is a cement and canvas covering for pulley surfaces designed to increase the adhesion of the belt.

PIPE BENDER.—Bulletin No. 5,001 of the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, is a folder entitled Bending Pipe with Hydraulic Power. It deals with a recently developed hand operated pipe bender manufactured by this company, having a pressure capacity of 30 tons.

STEAM TRAP.—Catalog No. 8 of the Automatic Steam Trap & Specialty Company, Detroit, Mich., is devoted to the Barton expansion automatic steam trap which is manufactured by this company. In addition to the price list the catalog contains a number of illustrations of traps in service and a number of testimonials from users of the device.

THREADING TOOLS.—The Oster Manufacturing Company, Cleveland, Ohio, has recently brought out its list No. 28 of Oster threading tools. This is a 64 page catalog containing illustrations and price lists of die stocks, light hand machines, screw plates, recutting dies and power machines. The operation of several types of Oster die stocks is described.

COAL DRIER.—Bulletin No. 212 of the Link-Belt Company, Chicago, describes the Wendell continuous automatic coal drier which is designed to dry washed coal for coking purposes and the smaller sizes of steam and domestic coal. The booklet is a four-page folder and contains a number of illustrations, among which is a diagram showing the method of operating the machine.

GRAPHIC METHODS.—The Statistics Bureau, 5 East Forty-second street, New York, has issued a 20-page catalog entitled Materials for the Graphic Presentation of Facts. It deals with drawing room material, cross section paper, maps and other materials for statistical work, and in addition contains a list of books dealing with the general subject of graphic presentation of facts.

COMPRESSED AIR.—The Blaisdell Machinery Company, Bradford, Pa., has recently issued a loose-leaf catalog which is devoted to its line of air compressors, vacuum cleaning system and accessories. It is well illustrated and contains considerable information relative to the installation and operation of compressed air equipment in addition to the description of the devices manufactured by the company.

BOILER MAKERS' TOOLS.—A 40-page catalog has recently been issued by the J. Faessler Manufacturing Company, Moberly, Mo., which is devoted to the general line of boiler makers' tools manufactured by this company, together with its special flue cutting and countersinking tools. The catalog is well illustrated and contains price lists as well as information concerning the operation of the various tools.

TITANIUM ALUMINUM BRONZE.—An eight-page booklet just issued by the Titanium Alloy Manufacturing Company, Niagara Falls, N. Y., deals with the use of Titanium as a deoxidizer in alloys of aluminum and copper. The booklet contains a number of extracts from some reports setting forth the properties of aluminum and copper alloys, the practical casting of which has been facilitated by the use of Titanium.

FORGING HAMMERS.—Catalog No. 66 of the Chambersburg Engineering Company, which has just been issued, is devoted to a representative line of the different types of steam hammers manufactured by this company. This is a 64-page, 8½-in. by 11-in. catalog in which the features of Chambersburg hammers are described in some detail. It contains a complete index of machinery built by this company, including several lines not shown in the catalog.

OXY-ACETYLENE APPARATUS.—Catalog No. 111 of the Imperial Brass Manufacturing Company, Harrison street and Racine avenue, Chicago, deals with oxy-acetylene welding and cutting outfits, torches, regulators, gages and other accessories. In addition to the usual information concerning such apparatus, the catalog contains a number of illustrations showing the torches in operation on various classes of work and examples of broken parts repaired by the Imperial outfit.

ELECTRIC HOISTS.—The Link-Belt Company, Chicago, in its bulletin No. 207 sets forth the special features of the Link-Belt electric hoists. These are of the monorail type, having a capacity up to four tons and are built with either a plain trolley, a geared trolley propelled by a hand chain, a motor driven trolley with pendant cords for operation from below, or with an operator's cage suspended from the hoist. These hoists may also be provided with a shackle or hook suspension in place of the trolley, making them suitable for stationary work.

HYDRAULIC PRESSES AND PUMPS.—The Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, has issued a booklet in which a few of the various hydraulic appliances manufactured by this company are described and illustrated. The development of the business of this company as well as its present organization is briefly set forth and the plant described. The booklet is intended for distribution to visitors at the exhibit of this company at the Panama-Pacific International Exposition and contains a list of catalogs dealing in detail with various classes of hydraulic equipment, which are now ready for distribution.

FOUNDRY CRANES AND EQUIPMENT.—Catalog No. 99 from the Whiting Foundry Equipment Company, Harvey, Ill., is intended to furnish foundry men in condensed form descriptions and illustrations of the cranes and foundry machinery manufactured by this company for the equipment of complete foundry plants. The catalog contains 40 pages and is completely illustrated, the equipment covered including, besides cranes, overhead trolley systems, air hoists, cupola charging machines, bottom door hoists, elevators, core ovens, core oven cars, ladles, tumblers, brass furnaces, sand sifters, converter steel, malleable foundry and pipe foundry plants.

OXY-ACETYLENE WELDING AND CUTTING.—The Vulcan Process Company, Minneapolis, Minn., has issued a pamphlet outlining the use of its oxy-acetylene outfit, which includes an acetylene generator, in railway shops. It contains descriptions of some of the work performed by this equipment with the corresponding savings made in doing the repairs by this method. A table is included showing the cost of cutting and the cost of welding. The cost per foot of cutting ranges from $0.0126 for one-quarter-inch plate to $0.041 for 1½-in. plate and the cost per foot of welding ranges from $0.045 for one-eighth-inch plate to $1.24 for five-eighths-inch plate.

STEAM ENGINE-DRIVEN GENERATOR SETS.—In bulletin No. 42,300, recently issued by the General Electric Company, Schenectady, N. Y., that company's line of small direct connected generating sets, of sizes ranging from 2½ kw. to 75 kw., is described. While ordinarily designed to meet the severe conditions of marine work demanding light, compact and durable sets of close regulation and quiet operation, they are also well adapted and used extensively for both power and lighting in isolated plants, and as exciters for alternating current generators in central station work. Both the engine and generator are described in the bulletin in considerable detail.